This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

ANNUAL REPORT

OF THE

SECRETARY OF WAR

FOR

THE YEAR 1892.

IN FOUR VOLUMES.

VOLUME II—IN FOUR PARTS AND ATLAS.
PART 1.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1892.

LELAND STANFORD JUNIOR
LIBRARY
UNIVERSITY

A. 14197

CONTENTS.

[Alphabetical index will be found at the end of each part.]

PART I.

OFFICERS OF THE CORPS OF ENGINEERS.

STATUS, changes, and distribution of officers of corps, 3; officers detached, 4.

FORTIFICATIONS.

APPROPRIATIONS AND ALLOTMENTS, Boston Harbor, Mass., 4; New York Harbor, N. Y., 5; Washington, D. C., 7; Hampton Roads, Va., San Francisco, Harbor, Cal., mining casemates, 8; sites for fortifications, 9.

PROTECTION OF SITE OF FORT NIAGARA, NEW YORK.

IN THE CHARGE OF CAPT. DAN C. KINGMAN, CORPS OF ENGINEERS 12

SEA WALL AND EMBANKMENT AT DAVIDS ISLAND, NEW YORK HARBOR.

IN THE CHARGE OF COL. D. C. HOUSTON, CORPS OF ENGINEERS 12

SEA WALLS AT GOVERNORS ISLAND, NEW YORK HARBOR.

IN THE CHARGE OF COL. D. C. HOUSTON, CORPS OF ENGINEERS 13

BEACH PROTECTION, WATER SUPPLY, AND SEWERAGE SYSTEM AT FORT MONROE, VA.

IN THE CHARGE OF MAJ. CHAS. E. L. B. DAVIS, CORPS OF ENGINEERS.... 14

REPAIR AND PRESERVATION OF FORT MARION, FLORIDA.

IN THE CHARGE OF MAJ. J. C. MALLERY, CORPS OF ENGINEERS 15

ESTIMATES OF APPROPRIATIONS FOR FORTIFICATIONS REQUIRED FOR 1893-'94 15

THE BOARD OF ENGINEERS.

CONSTITUTION of Board, summary of reports rendered, 16; personal inspections made, 17; additional duties of members, 18.

POST OF WILLETS POINT, NEW YORK.—UNITED STATES ENGINEER SCHOOL.—BATTALION OF ENGINEERS.—ENGINEER DEPOT.

OFFICER IN COMMAND, LIEUT. COL. W. R. KING, CORPS OF ENGINEERS—

Post of Willets Point, United States Engineer School, Battalion of Engineers, Engineer Depot, 19; statement of funds, estimates, 20.

RIVER AND HARBOR IMPROVEMENTS.

GENERAL STATEMENT, estimates, removal of wrecks, establishment of harbor lines, examination of bills for bridges, construction of bridges across navigable waters, obstructions to navigation, 21; occupancy and injury of public works, engineer divisions, South Pass of the Mississippi River, rules and regulations for the use of canals, 22.

ATLANTIC COAST AND GULF OF MEXICO.

IN THE CHARGE OF LIEUT. COL. PETER C. HAINS, CORPS OF ENGINEERS—

St. Croix River, Me., 23; Lubec Channel, Me., Moosabec Bar, Me., Pleasant River, Me., 24; Narraguagus River, Me., breakwater from Mount Desert to Porcupine Island, Me., 25; Bagaduce River, Me., 26; Penobscot River, Me., 27; Belfast Harbor, Me., Camden Harbor, Me., 28; Rockport Harbor, Me., Rockland Harbor, Me., 29; Kennebec River. Me., 30; Harraseeket River, Me., 31; Portland Harbor, Me., 32; channel in Back Cove, Portland, Me., 33; Saco River, Me., 34; Kennebunk River, Me., York Harbor, Me., 35; Portsmouth Harbor, N. H., Bellamy River, N. H., 36; Cocheco River, N. H., 37; harbor of refuge at Little Harbor, N. H., 38; removing sunken vessels or craft obstructing or endangering navigation, examinations and surveys, 39.

IN THE CHARGE OF LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS—

Newburyport Harbor, Mass., Merrimac River, Mass., 40; Powow River, Mass., 41; Ipswich River, Mass., harbor of refuge, Sandy Bay, Cape Ann, Mass., 42; Gloucester Harbor, Mass., 43; Manchester Harbor, Mass., Salem Harbor, Mass., 44; Lynn Harbor, Mass., 45; Winthrop Harbor, Mass., Boston Harbor, Mass., 46; Weymouth River, Mass., Hingham Harbor, Mass., 48; Scituate Harbor, Mass., 49; Plymouth Harbor, Mass., Wellfleet Harbor, Mass., 50; Provincetown Harbor, Mass., Chatham Harbor, Mass., 51.

IN THE CHARGE OF CAPT. W. H. BIXBY, CORPS OF ENGINEERS—

Harbor of refuge at Hyannis, Mass., 52; harbor of refuge at Nantucket, Mass., Marthas Vineyard inner harbor at Edgartown, Mass., 53; Vineyard Haven Harbor, Mass., Wareham Harbor, Mass., 54; New Bedford Harbor, Mass., 55; Westport Harbor, Mass, 56; Taunton River, Mass., 57; Pawtucket River, R. I., 58; Providence River and Narragansett Bay, R. I., removal of Green Jacket Shoal, Providence River, R. I., 59; Greenwich Bay, R. I., cove and waterway near Coaster Harbor Island, R. I., 60; Newport Harbor, R. I., 61; harbor of refuge at Point Judith, R. I., 62; harbor of refuge at Block Island, R. I., 63; Pawcatuck River, R. I. and Conn., 64; harbor of refuge at Stonington, Conn., removing sunken vessels or craft obstructing or endangering navigation, 65; examinations and surveys, 66.

IN THE CHARGE OF COL. D. C. HOUSTON, CORPS OF ENGINEERS—

Mystic River, Conn., Thames River, Conn., 67; Connecticut River, Mass. and Conn., 68; Duck Island Harbor, Conn., 70; Clinton Harbor, Conn., New Haven Harbor, Conn., 71; breakwater at New Haven, Conn., 72; Milford Harbor, Conn., Housatonic River, Conn., 73; Bridgeport Harbor, Conn., 74; Black Rock Harbor, Conn., Norwalk Harbor, Conn., 75; Wilsons Point Harbor, Conn., Five Mile River Harbor, Conn., 76; Stamford Harbor, Conn., Port Chester Harbor, N. Y., 77; Larchmont Harbor, N. Y., 78; Echo Harbor, New Rochelle, N. Y., East Chester Creek, N. Y., 79; Greenport Harbor, N. Y., harbor at Port Jefferson Inlet, N. Y., 80; Huntington Harbor, N. Y., 81; Glen Cove Harbor, N. Y., Flushing Bay, N. Y., 82; Patchogue River, N. Y., Browns Creek, Sayville, N. Y., 83.

IN THE CHARGE OF LIEUT. COL. G. L. GILLESPIE, CORPS OF ENGINEERS—

Hudson River, N. Y. 84; harbor at Saugerties, N. Y., 86; harbor at Rondout, N. Y., 87; Wappinger Creek, N. Y., Harlem River, N. Y., 88; East River and Hell Gate, N. Y., 90; Newtown Creek, N. Y., 91; Buttermilk Channel, New York Harbor, 92; Gowanus Bay, N. Y., 93; New York Harbor, N. Y., 95; Raritan Bay, N. J., 96; removing sunken vessels or craft obstructing or endangering navigation, examination and survey, 97.

In the charge of Capt. Thomas L. Casey, Corps of Engineers—

Sumpawanus Inlet, N. Y., Canarsie Bay, N. Y., 98; Sheepshead Bay, N. Y., 99; Arthur Kill, N. Y. and N. J., 100; channel between Staten Island and New Jersey, 101; Passaic River, N. J., 102; Elizabeth River, N. J., 103; Rahway River, N. J., Raritan River, N. J., 104; South River, N. J., 105; Keyport Harbor, N. J., 106; Mattawan Creek, N. J., 107; Shoal Harbor and Compton Creek, N. J., Shrewsbury River, N. J., 108; Manasquan River, N. J., 109.

In the charge of Maj. C. W. Raymond, Corps of Engineers—

Delaware River, Pa. and N. J., 110; harbor between Philadelphia Pa., and Camden, N. J., 112: Schuylkill River, Pa., 113; ice harbor at Marcus Hook, Pa., 114; ice harbor at head of Delaware Bay, Del., construction of iron pier in Delaware Bay, near Lewes, Del., 115; Delaware Breakwater, Del., 116; Rancocas River, N. J., 117; Alloway Creek, N. J., 118; Maurice River, N. J., removing sunken vessels or craft obstructing or endangering navigation, examination, 119.

In the charge of William F. Smith, United States Agent, Major of Engineers, U. S. Army, Retired—

Wilmington Harbor, Del., 120; ice harbor at New Castle, Del., Appoquinnimink River, Del., Smyrna River, Del., 121; Mispillion Creek, Del., 122; Broadkiln River, Del., inland waterway from Chincoteague Bay, Va., to Delaware Bay at or near Lewes, Del., 123; Susquehanna River above and below Havre de Grace, Md., North East River, Md., 124; Elk River, Md., 125; Fairlee Creek, Md., Chester River, Md., from Crumpton to Jones Landing, 126; Choptank River, Md., Cambridge Harbor. Md., 127; Wicomico River, Md., 128; Manokin River, Md., Onancock Harbor, Va., 129; harbor at Cape Charles City, Va., and approaches by Chenton Inlet, 130; removing sunken vessels or craft obstructing or endangering navigation, examinations and surveys, 131.

In the charge of Col. William P. Craighill, Corps of Engineers—

Patapsco River and channel to Baltimore, Md., 132; James River, Va., 134.

In the charge of Maj. Charles E. L. B. Davis, Corps of Engineers—

Potomac River at Washington, D. C., 136; Potomac River at Mount Vernon, Va., 138; Occoquan Creek, Va., 139; Aquia Creek, Va., 140; harbor at Breton Bay, Leonardtown, Md., Nomini Creek, Va., 141; Patuxent River, Md., 142; Rappahannock River, Va., Urbana Creek, Va., 143; York River, Va, 144; Mattaponi River, Va., 145; Pamunkey River, Va., examinations and surveys, 146.

In the charge of Lieut. Edw. Burr, Corps of Engineers—

Harbor of Norfolk, and its approaches, Va., 147; approach to Norfolk Harbor and the United States (Norfolk) navy-yard between Lambert Point and Fort Norfolk, 149; Hampton Creek and Bar, Va., Nansemond River, Va., 150; Chickahominy River, Va., 151; Appomattox River, Va., inland water route from Norfolk Harbor, Va., to Albemarle Sound, N. C., through Currituck Sound, 152; North Landing River, Va., and N. C., 153.

In the charge of Maj. W. S. Stanton, Corps of Engineers—

Staunton River, Va., 154; Roanoke River, N. C., 155; Pasquotank River, N. C., Mackeys Creek, N. C., 156; Ocracoke Inlet, N. C., Fishing Creek, N. C., 157; Pamlico and Tar River, N. C., Contentnia Creek, N. C., 158; Trent River, N. C., 159; Neuse River, N. C., 160; inland waterway between Newberne and Beaufort, N. C., harbor at Beaufort, N. C., 161; inland waterway between Beaufort Harbor and New River, N. C., 162; inland waterway between New River and Swansboro, N. C., New River, N. C., 163; North East (Cape Fear) River, N. C., Black River, N. C., 164; Cape Fear River, N. C., above Wilmington, Cape Fear River, N. C., at and below Wilmington, 165; Lockwoods Folly River N. C., 167; Yadkin River, N. C., harbor at Georgetown, S. C., 168; Winyaw Bay, S. C., removing sunken vessels or craft obstructing or endangering navigation, 169.

In the charge of Capt. Frederic V. Abbot, Corps of Engineers—

Waccamaw River, N. C. and S. C., Lumber River, N. C. and S. C., 170; Little Pedee River, S. C., Great Pedee River, S. C., Clark River, S. C., Mingo Creek, S. C., 171; Santee River, S. C., Wateree River, S. C., 172; Congaree River, S. C., Charleston Harbor, S. C., 173; Ashley River, S. C., Wappoo Cut, S. C., Edisto River, S. C., 174; Salkahatchie River, S. C., Beaufort River, S. C., removing sunken vessels or craft obstructing or endangering navigation, 175.

In the charge of Capt. O. M. Carter, Corps of Engineers—

Savannah Harbor, Ga., 175; Savannah River, Ga., 176; Darien Harbor, Ga., Altamaha River, Ga., 177; Oconee River, Ga., Ocmulgee River, Ga., 178; Brunswick Harbor, Ga., Jekyl Creek, Ga., 179; Cumberland Sound, Ga. and Fla., removing sunken vessels or craft obstructing or endangering navigation, 180; examinations and surveys, 181.

In the charge of Maj. J. C. Mallery, Corps of Engineers—

St. Johns River, Fla., 182; Ocklawaha River, Fla., 183; Volusia Bar, Fla., 184; harbor at St. Augustine, Fla., 185; northwest entrance, Key West Harbor, Fla., 186; Caloosahatchee River, Fla., channel of Charlotte harbor and Pease Creek, Fla., 187; Sarasota Bay, Fla., Manatee River, Fla., 188; Tampa Bay, Fla., 189; Withlacoochee River, Fla., 190; harbor at Cedar Keys, Fla., Suwanee River, Fla., 191.

In the charge of Capt. Philip M. Price, Corps of Engineers—

Apalachicola Bay, Fla., 192; Apalachicola River, Fla., 193; Flint River, Ga., 194; Chattahoochee River, Ga. and Ala., 195; Lagrange Bayou and Holmes River, Fla., 196; Choctawhatchee River, Fla. and Ala., 197; harbor at Pensacola, Fla., 198; Escambia and Conecuh rivers, Fla. and Ala., 199; Alabama River, Ala., 200; Tallapoosa River, Ala., 201; Coosa River, Ga. and Ala., 202; operating and care of canals and other works of navigation on Coosa River, Ga. and Ala., Cahaba River, Ala., 204.

In the charge of Maj. A. N. Damrell, Corps of Engineers—

Mobile Harbor, Ala., Black Warrior River, Ala., from Tuscaloosa to Daniels Creek, 206; Warrior and Tombigbee rivers, Ala. and Miss., 207; Noxubee River, Miss., Pascagoula River, Miss., 210; Chickasahay River, Bluff Creek, Miss., Leaf River, Miss., 211; harbor at Biloxi, Miss., Pearl River, Miss., below Jackson, 212; Pearl River, Miss., between Jackson and Carthage, 213; Pearl River, Miss., between Edinburg and Carthage, Bogue Chitto, La., 214.

In the charge of Maj. James B. Quinn, Corps of Engineers—

Inspection of the improvement of the South Pass of the Mississippi River, Chefuncte River, and Bogue Falia, La., 215; Tickfaw River and its tributaries, La., 216; Amite River and Bayou Manchac, La., Bayou Lafourche, La., 217; Bayou Terrebonne, La., Bayou Plaquemine, La., 218; Bayou Courtableau, La., 219; Bayou Teche, La., mouth and passes of Calcasieu River, La., 220; harbor at Sabine Pass, Tex., 221; Sabine River, Tex., Neches River, Tex., 222; removing sunken vessels or craft obstructing or endangering navigation, examination, 223.

In the charge of Capt. John Millis, Corps of Engineers—

Securing mouth of Bayou Plaquemine, La., from further caving, 223; removing sunken vessels or craft obstructing or endangering navigation in Mississippi River below New Orleans, La., 224.

In the charge of Maj. Charles J. Allen, Corps of Engineers—

Entrance to Galveston Harbor, Tex., 224; ship channel in Galveston Bay, Tex., 225; Trinity River, Tex., 226; Cedar Bayou, Tex., Buffalo Bayou, Tex., harbor at Brazos Santiago, Tex., 227; examinations and survey, 228.

WESTERN RIVERS.

IN THE CHARGE OF CAPT. J. H. WILLARD, CORPS OF ENGINEERS—

Red River, La. and Ark., 229; Red River above Fulton, Ark., 230; Ouachita and Black rivers, Ark. and La., 231; Bayou D'Arbonne, La., Bayou Bartholomew, La. and Ark., 232; Bayou Bœuf, La., Tensas River and Bayou Macon, La., 233; bayous Bondeway and Vidal, La., Big Black River, Miss., 234; Yazoo River, Miss., 235; Tchula Lake, Miss., Tallahatchee River, Miss., 236; Steele Bayou and Washington Bayou, Miss., 237; Big Sunflower River, Miss., Big Hatchee River, Tenn., 238; Forked Deer River, Tenn., water-gauges on Mississippi River and its principal tributaries, 239; survey of Cypress Bayou and the lakes between Jefferson, Tex., and Shreveport, La., 240.

IN THE CHARGE OF CAPT. H. S. TABER, CORPS OF ENGINEERS—

Removing obstructions in Arkansas River, Arkansas River, 241; Fourche Le Fevre River, Ark., Petit Jean River, Ark., 243; White River, Ark., Cache River, Ark., 244; Little Red River Ark., Black River, Ark. and Mo., 245; Black River, Mo., St. Francis River, Ark., 246; St. Francis River, Mo., Little River, Mo., examination and survey, 247.

IN THE CHARGE OF MAJ. A. M. MILLER, CORPS OF ENGINEERS—

Removing snags and wrecks from Mississippi River, 248; Mississippi River between the Ohio and Illinois rivers, 249; harbor at St. Louis, Mo., 250; Gasconade River, Mo., Osage River, Mo., 251; Kaskaskia River, Ill., 252.

IN THE CHARGE OF MAJ. A. MACKENZIE, CORPS OF ENGINEERS—

Operating snag boats and dredge boats on Upper Mississippi River, Mississippi River between Des Moines Rapids and mouth of Illinois River, 253; Des Moines Rapids, Mississippi River, 254; operating and care of Des Moines Rapids Canal and Dry Dock, Mississippi River between Minneapolis and Des Moines Rapids, 255.

IN THE CHARGE OF MAJ. W. A. JONES, CORPS OF ENGINEERS—

Mississippi River above Falls of St. Anthony, Minn., 256; reservoirs at head waters of Mississippi River, 257; Chippewa River, including Yellow Banks, Wis., 258; St. Croix River, Wis. and Minn., 259; Minnesota River, Minn., 260; Red River of the North, Minn. and N. Dak., gauging Mississippi River at or near St. Paul, Minn., 261; examination and survey, 262.

IN THE CHARGE OF CAPT. CHAS. F. POWELL, CORPS OF ENGINEERS—

Missouri River between the Great Falls, Mont., and Sioux City, Iowa, 263; Yellowstone River, Mont. and N. Dak., 264; examination, 265.

IN THE CHARGE OF LIEUT. COL. HENRY M. ROBERT, CORPS OF ENGINEERS—

Tennessee River above Chattanooga, Tenn., and below Bee Tree Shoals, Ala., 266; Hiawassee River, Tenn., 267; French Broad River, Tenn., 268; Clinch River, Tenn., 269; Cumberland River, Tenn. and Ky., 270; Caney Fork River, Tenn., 272; South Fork of Cumberland River, Ky., 273.

IN THE CHARGE OF CAPT. GEORGE W. GOETHALS, CORPS OF ENGINEERS—

Tennessee River between Chattanooga, Tenn., and foot of Bee Tree Shoals, Ala., 273; operating and care of Muscle Shoals Canal, Tennessee River, 275.

IN THE CHARGE OF MAJ. AMOS STICKNEY, CORPS OF ENGINEERS—

Ohio River, 275; operating snag boats on Ohio River, operating and care of Davis Island Dam, Ohio River, 277; movable dam in Ohio River below mouth of Beaver River, Pa., Monongahela River, W. Va. and Pa., 278; operating and care of locks and dams Nos. 8 and 9, Monongahela River, purchase of lock and dam No. 7, Monongahela River, purchase of lock and dam No. 6, Monongahela River, Cheat River, W. Va., 279; Allegheny River, Pa., dam at Herr Island, Allegheny River, Pa., 280; ice harbor at mouth of Muskingum River, Ohio, operating and care of ice harbor lock at mouth of Muskingum River, Ohio, Muskingum River, Ohio, 281; operating and care of locks and dams on Muskingum River, Ohio, 282.

IN THE CHARGE OF LIEUT. COL. G. J. LYDECKER, CORPS OF ENGINEERS—

Falls of the Ohio River, Louisville, Ky., Indiana Chute, Falls of the Ohio River, 283; operating and care of Louisville and Portland Canal, Ky., Wabash River, Ind. and Ill., 284; White River, Ind., 285.

IN THE CHARGE OF COL. WILLIAM P. CRAIGHILL, CORPS OF ENGINEERS—

Great Kanawha River, W. Va., 286; operating and care of locks and dams on Great Kanawha River, W. Va., Elk River, W. Va., 287; Gauley River, W. Va., 288; New River, Va. and W. Va., 289.

IN THE CHARGE OF MAJ. D. W. LOCKWOOD, CORPS OF ENGINEERS—

Tradewater River, Ky., operating and keeping in repair locks and dams on Green and Barren rivers, Ky., 290; Rough River, Ky., Kentucky River, Ky., 291; operating and keeping in repair locks and dams on Kentucky River, Ky., Licking River, Ky., between Farmers and West Liberty, 292; Big Sandy River, W. Va. and Ky., Levisa Fork, Big Sandy River, Ky., 293; Tug Fork, Big Sandy River, W. Va. and Ky., Guyandotte River, W. Va., 294; Little Kanawha River, W. Va., operating and keeping in repair the lock and dam on Little Kanawha River, W. Va., Buckhannon River, W. Va., 295.

LAKE HARBORS AND RIVERS.

IN THE CHARGE OF CAPT. W. L. FISK, CORPS OF ENGINEERS—

Harbor at Grand Marais, Minn., harbor at Agate Bay, Minn., 296; harbor at Duluth, Minn., 297; harbor at Superior Bay and St. Louis Bay, Wis., 298; Minnesota Point, at Superior, Wis., harbor at Ashland, Wis., harbor at Ontonagon, Mich., 299; Eagle Harbor, Mich., harbor at Marquette, Mich., 300; harbor of refuge at Grand Marais, Mich., 301; examination and survey, 302.

IN THE CHARGE OF MAJ. JAMES F. GREGORY, CORPS OF ENGINEERS—

Portage Lake and Lake Superior canals, across Keweenaw Point, Mich., 302; Manistique Harbor, Mich., Cedar River Harbor, Mich., 303; Menominee Harbor, Mich. and Wis., Menominee River, Mich. and Wis., 304; Oconto Harbor, Wis., Pensaukee Harbor, Wis., 305; Green Bay Harbor, Wis., harbor of refuge at entrance of Sturgeon Bay Canal, Wis., 306; Ahnapee Harbor, Wis., 307; Kewaunee Harbor, Wis., Two Rivers Harbor, Wis., 308; Manitowoc Harbor, Wis., Sheboygan Harbor, Wis., 309; Port Washington Harbor, Wis., 310; harbor of refuge at Milwaukee Bay, Wis., Milwaukee Harbor, Wis., 311; Racine Harbor, Wis., Kenosha Harbor, Wis., 312; Waukegan Harbor, Ill., 313; Fox River, Wis., 314; operating and care of locks and dams on Fox River, Wis., 315.

IN THE CHARGE OF CAPT. W. L. MARSHALL, CORPS OF ENGINEERS—

Chicago Harbor, Ill., 315; Calumet Harbor, Ill., 316; Calumet River, Ill. and Ind., 317; Illinois River, Ill., 318; operating and care of Lagrange Lock and Dam, Illinois River, Ill., 319; Illinois and Mississippi Canal, 320.

IN THE CHARGE OF MAJ. WILLIAM LUDLOW, CORPS OF ENGINEERS—

Petoskey Harbor, Mich., 321; Charlevoix Harbor and entrance to Pine Lake, Mich., Frankfort Harbor, Mich., 322; harbor of refuge at Portage Lake, Mich., Manistee Harbor, Mich., 323; Ludington Harbor, Mich., Pentwater Harbor, Mich., 324; White River Harbor, Mich., Muskegon Harbor, Mich., 325; Grand Haven Harbor, Mich., 326; Holland Harbor, Mich., 327; Saugatuck Harbor, Mich., South Haven Harbor, Mich., 328; St. Joseph Harbor, Mich., 329; St. Joseph River, Mich., Michigan City Harbor, Ind., 330; examination and survey, 331.

IN THE CHARGE OF COL. O. M. POE, CORPS OF ENGINEERS—

St. Marys River, Mich., 331; operating and care of St. Marys Falls Canal, Mich., 332; dry dock at St. Marys Falls Canal, Mich., Hay Lake Channel, St. Marys River, Mich., 333; harbor at Cheboygan, Mich., 334; harbor at Thunder Bay, Mich., Thunder Bay River, Mich., 335; harbor at Au Sable, Mich., Saginaw River, Mich., 336; harbor of refuge at Sand Beach, Lake Huron, Mich., 337; Black River at Port Huron, Mich., mouth of Black River, Mich., 339; St. Clair Flats Canal, Mich., 340; operating and care of St. Clair Flats Canal, Mich., Clinton River, Mich., 341; Grosse Pointe Channel, Mich., 342; Rouge River, Mich., Detroit River, Mich., 343; removing sunken vessels or craft obstructing or endangering navigation, 344.

In the charge of Lieut. Col. Jared A. Smith, Corps of Engineers—

Monroe Harbor, Mich., 344; Toledo Harbor, Ohio, 345; Port Clinton Harbor, Ohio, Sandusky City Harbor, Ohio, 346; Sandusky River, Ohio, Huron Harbor, Ohio, 347; Vermillion Harbor, Ohio, 348; Black River Harbor, Ohio, Cleveland Harbor, Ohio, 349; Fairport Harbor, Ohio, 350; Ashtabula Harbor, Ohio, 351; removing sunken vessels or craft obstructing or endangering navigation, examinations and surveys, 352.

In the charge of Maj. E. H. Ruffner, Corps of Engineers—

Erie Harbor, Pa., 352; preservation and protection of peninsula at Presque Isle, Erie Harbor, Pa., Dunkirk Harbor, N. Y., 353; Buffalo Harbor, N. Y., 354; Tonawanda Harbor and Niagara River, N. Y., Wilson Harbor, N. Y., 355; Olcott Harbor, N. Y., Oak Orchard Harbor, N. Y., 356; examination and survey, 357.

In the charge of Capt. Dan C. Kingman, Corps of Engineers—

Charlotte Harbor, N. Y., 357; Pultneyville Harbor, N. Y., harbor at Great Sodus Bay, N. Y., 358; harbor at Little Sodus Bay, N. Y., 359; Oswego Harbor, N. Y., 360; harbor at Sacketts Harbor, N. Y., 361.

In the charge of Maj. M. B. Adams, Corps of Engineers—

Shoals between Sister Islands and Crossover Light, St. Lawrence River, N. Y., Ogdensburg Harbor, N. Y., 362; breakwater at Rouse Point, Lake Champlain, N. Y., Great Chazy River, N. Y., breakwater at Gordon Landing, Lake Champlain, Vt., 363; Plattsburg Harbor, N. Y., Burlington Harbor, Vt., 364; Otter Creek, Vt., Ticonderoga River, N. Y., Narrows of Lake Champlain, N. Y. and Vt., 365.

PACIFIC COAST.

In the charge of Col. G. H. Mendell, Corps of Engineers—

Oakland Harbor, Cal., 365.

In the charge of Lieut. Col. W. H. H. Benyaurd, Corps of Engineers—

Napa River, Cal., Redwood Creek, Cal., 367; San Luis Obispo Harbor, Cal., Wilmington Harbor, Cal., 368; San Diego Harbor, Cal., 369; examination, 370.

In the charge of Maj. W. H. Heuer, Corps of Engineers—

San Joaquin River, Cal., 370; Mokelumne River, Cal., Sacramento and Feather rivers, Cal., 372; Petaluma Creek, Cal., Humboldt Harbor and Bay, Cal., 373.

In the charge of Capt. Thomas W. Symons, Corps of Engineers—

Coquille River, Oregon, 375; entrance and harbor at Coos Bay, Oregon, 376; Umpqua River, Oregon, 377; mouth of Siuslaw River, Oregon, harbor at Yaquina Bay, Oregon, 378; Tillamook Bay and Bar, Oregon, 379; entrance to Nehalem Bay, Oregon, Upper Columbia and Snake rivers, Oregon and Wash., 380; Columbia River, between head of Rock Island Rapids and foot of Priest Rapids, Wash., 381; Chehalis River, Wash., 382; Skagit, Stillaguamish, Nooksack, Snohomish, and Snoqualmie rivers, Wash., 383; examinations and surveys, 384.

In the charge of Maj. Thomas H. Handbury, Corps of Engineers—

Mouth of Columbia River, Oregon and Wash., 386; construction of canal at the Cascades, Columbia River, Oregon, 388; Columbia and Lower Willamette rivers below Portland, Oregon, 389; Williamette River above Portland, Oregon, 391; Cowlitz River, Wash., 392; Youngs and Klaskuine rivers, Oregon, gauging waters of Columbia River, Oregon and Wash., examinations and surveys, 393.

SUPERVISION OF THE HARBOR OF NEW YORK........... 395

MISSISSIPPI RIVER COMMISSION.................. 396

MISSOURI RIVER COMMISSION..................... 397

HARBOR LINES.................................. 397

Five Mile River Harbor, Conn., New York Harbor and its adjacent waters, Anacostia River at Washington, D. C., 398; South Branch of Elizabeth River at navy-yard, Norfolk, Va., San Pedro, Wilmington Harbor, Cal., San Diego Harbor and adjacent waters, Cal., Olympia Harbor, Vancouver Harbor, and Bellingham Bay, Wash., Willamette River at Portland, Oregon, 399.

BRIDGING NAVIGABLE WATERS OF THE UNITED STATES.

(1) Bridge of city of Snohomish, Wash., across Snohomish River, (2) bridge of Valley Street Railway Company across Duwamish River, in section 29, township 24 north, range 4 east, Washington, (3) bridge of Cherry Island Marsh Company across Brandywine Creek at Wilmington, Del., (4) bridge of Clatsop County, Oregon, across Walluski River, (5) bridges of Snohomish, Skykomish and Spokane Railway and Transportation Company across Snohomish River, in section 32, township 29 north, range 5 east, Washington, and across Ebey Slough, in section 4, township 28 north, range 5 east, Washington, 400; (6) bridge of Litchfield, Carrollton and Western Railroad Company across Illinois River between Columbiana and Kampsville, Ill., (7) bridge of Nashville, Chattanooga and St. Louis Railway Company across Tennessee River at Johnsonville, Tenn., (8) bridge of Lewis County, Washington, across Cowlitz River at Toledo, (9) bridge of Navesink Railroad Company across Shrewsbury River at Highland Beach, N. J., (10) bridge of Delaware Railroad Company across Christiana River, Newcastle County, Del., 401; (11) bridge of Limestone County, Ala., across Elk River at Elk River Mills, (12) bridge of board of park commissioners of Boston, Mass., across navigable waterway between Boston and Castle Island, (13) bridge of Oregonian Railroad Company across Yamhill River, near Lafayette, Oregon, (14) bridge of Ocean Springs Bridge Company across main channel of Fort Bayou at Ocean Springs, Miss., (15) bridge of Lake Shore and Michigan Southern Railway Company across Huron River at Huron, Ohio, (16) bridge of Milwaukee, Lake Shore and Western Railway Company across Sheboygan River at Sheboygan, Wis., (17) bridge of city of Albany, Oregon, across Willamette River, 402; (18) bridge of South Twenty-second Street Bridge Company across Monongahela River at Pittsburg, Pa., (19) bridge of Superior Belt Line and Terminal Railway Company across St. Louis River, Wisconsin and Minnesota, (20) bridge of North River Bridge Company across Hudson River at New York City, (21) bridge of Lake Shore and Michigan Southern Railway Company across Sandusky Bay, Ohio, (22) bridge of Chicago, Milwaukee and St. Paul Railway Company across Portage Canal near Portage City, Wis., (23) bridge of city of Oshkosh, Wis., across Fox River, 403; (24) bridge of city of Manitowoc, Wis., across Manitowoc River, (25) bridge of Wahkiakum County, Wash., across Alger Slough, (26) bridge of Milwaukee, Lake Shore and Western Railway Company across Wolf River at New London, Wis., (27) bridge of Plymouth and Barnstable counties, Mass., across Cohasset Narrows between towns of Wareham and Bourne, (28) bridge of Chicago, Milwaukee and St. Paul Railway Company across Chippewa River near Red Cedar, Wis., (29) bridge of Kenton County and Campbell County Bridge Company across Licking River between Newport and Covington, Ky., (30) bridge of Skagit County, Wash., across Swinomish Slough, 404; (31) bridge of Washington and Chesapeake Beach Railway Company across Patuxent River at Mount Calvert, Md., (32) bridge of Washington and Arlington Railway Company across Potomac River at the "Three Sisters" near Washington, D. C., (33) bridge of Leavenworth and Platte County Bridge Company across Missouri River at Leavenworth, Kans., (34) bridge of Warren County, Miss., across Big Black River at Baldwin Ferry, (35) bridge of Sagadahoc County, Me., across Atkins Bay, Kennebec River at Phippsburg, (36) bridge of Chehalis County, Wash., across Chehalis River at the Elbow Riffle, 405; (37) temporary and permanent bridges of New York Central and Hudson River Railroad Company across Harlem River at New York City, (38) bridge of Land and River Improvement Company of Everett across Snohomish River at Everett, Wash., (39) bridge of city of Chicago, Ill., across West Fork of South Branch of Chicago River, (40) temporary footbridge of Messrs. Hugh N. Camp and D. E. Seybel across Harlem River at New York City, (41) temporary bridge of city of New York across Harlem River, (42) bridge of the Macon, Dublin and Savannah Railroad Company across Ocmulgee River at Macon, Ga., 406, (43) bridge of town of Milbridge, Me., across Narraguagus River, (44) bridge of United Railroads of Washington across South Arm of Willapa River, Wash., (45) bridge of city of Boston, Mass., across Charles River, (46) bridge of Jacksonville, Tampa and Key West Railway Company across St. Johns River at Buffalo Bluff, Fla., (47) bridge of Galveston County, Tex., across West Bay, (48) bridge of Skagit County, Wash., across Skagit River at Mount Vernon, (49) bridge of Cincinnati and Covington Rapid Transit Bridge Company across Ohio River between Covington, Ky., and

Cincinnati, Ohio, (50) bridge of St. Paul, Minneapolis and Manitoba Railway Company across Snohomish River near Snohomish City, Wash., 407; (51) bridge of Allegheny Bridge Company across Allegheny River at Pittsburg, Pa., (52) bridge of Whatcom County, Wash., across Nooksack River at Ferndale, (53) bridge of Whatcom County, Wash., across Nooksack River at Lynden, (54) bridge of Albemarle and Raleigh Railroad Company across Tar River at Tarboro, N. C., (55) bridge of Kanawha and Michigan Railway Company across Gauley River, Fayette County, W. Va., (56) bridge of Boston Bridge Company across Youghiogheny River at Boston, Pa., (57) bridge of Chehalis County, Wash., across South Bay, Elk River, between Bay City and Laidlaw, 408; (58) bridge of Washington, Alexandria and Mount Vernon Electric Railway Company across Hunting Creek at Alexandria, Va., (59) bridges of Brazoria County, Tex., across Bastrop Bayou and Chocolate Bayou, (60) bridges of city of Portland, Oregon, across Willamette River, (61) bridge of Chicago, Peoria and Saint Louis Railway Company across Illinois River at Havana, Ill., (62) bridge of Chicago and Northwestern Railway Company across Fox River and Government Canal at De Pere, Wis., 409; (63) bridge of Relief Bridge Company across Allegheny River at Oil City, Pa., (64) bridge of Kewaunee, Green Bay and Western Railroad Company across Kewaunee River at Kewaunee, Wis., (65) bridge of city of Napa, Cal., across Napa River, (66) bridge of city of Milwaukee, Wis., across Kinnickinnic River, proposed bridge of city of Duluth, Minn., across canal at entrance of Duluth Harbor, 410.

BRIDGES OBSTRUCTING NAVIGATION.

(1) County bridge across Kentucky River at Frankfort, Ky., (2) Society Hill and Marlborough Bridge Company's bridge across Great Pedee River near Society Hill, S. C., (3) bridge across St. Joseph River, Mich., near its mouth, (4) bridge across Tulls Creek at Tulls, N. C., (5) highway bridge across Casper River, Ky., near its mouth, (6) drawbridge across Newtown Creek at Brooklyn, N. Y., 411; (7) highway bridge across Chippewa River at Durand, Wis., (8) bridge across Coopers Creek at Camden, N. J., (9) railroad bridge across Commencement Bay at Tacoma, Wash., (10) railroad bridge across Buffalo Bayou at Houston, Tex., (11) highway bridge across Buffalo Bayou at Houston, Tex., 412.

OCCUPANCY OF AND INJURY TO PUBLIC WORKS BY CORPORATIONS AND INDIVIDUALS 413

MISCELLANEOUS.

WASHINGTON AQUEDUCT.

IN THE CHARGE OF LIEUT. COL. GEORGE H. ELLIOT, CORPS OF ENGINEERS—

Washington Aqueduct, 413; water supply, District of Columbia, increasing water supply of Washington, D. C., 416; erection of fishways at Great Falls, 417.

PUBLIC BUILDINGS AND GROUNDS AND WASHINGTON MONUMENT, DISTRICT OF COLUMBIA.

IN THE CHARGE OF COL. O. H. ERNST, MAJOR, CORPS OF ENGINEERS........ 418

SURVEY OF THE NORTHERN AND NORTHWESTERN LAKES.

Printing and distribution of charts, survey of St. Marys River from White Fish Bay to Detour light-house, 419; shoals off Pelée Spit light-house and Littles Point, Lake Erie, Waverly Shoal, Lake Erie, shoals in St. Lawrence River, discharges of Niagara River, survey of lake front at Chicago, Ill., Black Creek Shoal, Lake Ontario, 420; estimates, 421; water levels, 422.

CONSTRUCTION AND IMPROVEMENT OF ROADS AND BRIDGES IN YELLOWSTONE NATIONAL PARK.

IN THE CHARGE OF MAJ. WILLIAM A. JONES, CORPS OF ENGINEERS.............. 422

MILITARY AND OTHER MAPS 423

RECONNAISSANCES AND EXPLORATIONS.

Officers on duty at headquarters of military departments, operations in Department of the Missouri, Department of the Columbia, Department of the Platte, Department of California, 424.

ESTIMATES FOR AMOUNTS REQUIRED FOR SURVEYS AND RECONNAISSANCES IN MILITARY DEPARTMENTS, AND FOR MAPS, INCLUSIVE OF WAR MAPS........ 425

OFFICE OF THE CHIEF OF ENGINEERS.

Officers in charge of divisions, 425.

STATEMENT SHOWING RANK AND DUTIES OF OFFICERS OF THE CORPS OF ENGINEERS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.. 427

FORTIFICATIONS, ETC.

APPENDIX No. 1.

REPORT OF CAPT. DAN C. KINGMAN, CORPS OF ENGINEERS.

Protection of site of Fort Niagara, N. Y., 453.

APPENDIX No. 2.

REPORT OF COL. D. C. HOUSTON, CORPS OF ENGINEERS.

Improvements.—Sea wall and embankment at Davids Island, New York Harbor, 457; sea walls on Governors Island, New York Harbor, 461.

APPENDIX No. 3.

REPORT OF MAJ. CHAS. E. L. B. DAVIS, CORPS OF ENGINEERS.

Improvements.—Beach protection at Fort Monroe, Va., 465; water supply at Fort Monroe, Va., 467; sewerage system at Fort Monroe, Va., 468.

APPENDIX No. 4.

REPORT OF MAJ. J. C. MALLERY, CORPS OF ENGINEERS.

Repair and preservation of Fort Marion, St. Augustine, Fla., 471.

APPENDIX No. 5.

REPORT OF LIEUT. COL. W. R. KING, CORPS OF ENGINEERS.

Post of Willets Point, N. Y., 473; United States Engineer School, 474; Battalion of Engineers, 475; Engineer depot, 479; experiments, 481; statement of funds, 481; new appropriations, 483; estimates, 484. Appendixes: A, programme of study and instruction for winter season, 484; B, instruction of enlisted men in mechanical trades, 487; C, programme of study and instruction for summer season, 487; D, tests of stone, 490; E, tests of wire rope, 491.

RIVERS AND HARBORS, ETC.

APPENDIX A.

REPORT OF LIEUT. COL. PETER C. HAINS, CORPS OF ENGINEERS.

Improvements.—St. Croix, River, Me., 494; Lubec Channel, Me., 495; Moosabec Bar, Me., 496; Pleasant River, Me., 498; Narraguagus River, Me., 498; breakwater from Mount Desert to Porcupine Island, Me., 500; Bagaduce River, Me., 502; Penobscot River, Me., 504; Belfast Harbor, Me., 507; Camden Harbor, Me., 509; Rockport Harbor, Me., 510; Rockland Harbor, Me., 511; Kennebec River, Me., 513; Harraseeket River, Me., 516; Portland Harbor, Me., 517; channel in Back Cove, Portland, Me., 520; Saco River, Me., 521; Kennebunk River, Me., 524; York Harbor, Me., 526; Portsmouth Harbor, N. H., 527; Bellamy River, N. H., 528; Cocheco River, N. H., 529; harbor of refuge at Little Harbor, N. H., 531; removing sunken vessels or craft obstructing or endangering navigation, 533.

Examinations and Surveys.—Penobscot River, Me., 533; Kennebec River, Me., from Waterville to steamboat wharf at Augusta, 541.

APPENDIX B.

REPORT OF LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS.

Improvements.—Newburyport Harbor, Mass., 551; Merrimac River, Mass., 554; Powow River, Mass., 556; Ipswich River, Mass., 557; harbor of refuge, Sandy Bay, Cape Ann, Mass., 558; Gloucester Harbor, Mass., 566; Manchester Harbor, Mass., 569; Salem Harbor, Mass., 570; Lynn Harbor, Mass., 572; Winthrop Harbor, Mass., 574; Boston Harbor, Mass, 575; Weymouth River, Mass., 584; Hingham Harbor, Mass., 585; Scituate Harbor, Mass., 586; Plymouth Harbor, Mass., 588; Wellfleet Harbor, Mass., 591; Provincetown Harbor, Mass., 593; Chatham Harbor, Mass., 595.

APPENDIX C.

REPORT OF CAPT. W. H. BIXBY, CORPS OF ENGINEERS.

Improvements.—Harbor of refuge at Hyannis, Mass., 598; harbor of refuge at Nantucket, Mass., 600; Marthas Vineyard, inner harbor at Edgartown, Mass., 602; Vineyard Haven Harbor, Mass., 604; Wareham Harbor, Mass., 607; New Bedford Harbor, Mass., 609; Westport Harbor, Mass., 612; Taunton River, Mass., 613; Pawtucket River, R. I., 616; Providence River and Narragansett Bay, R. I., 618; removal of Green Jacket Shoal, Providence River, R. I., 621; Greenwich Bay, R. I., 623; cove and water way near Coaster Harbor Island, R. I., 624; Newport Harbor, R. I., 625; harbor of refuge at Point Judith, R. I., 628; harbor of refuge at Block Island, R. I., 630; Pawcatuck River, R. I. and Conn., 633; harbor of refuge at Stonington, Conn., 635; removing sunken vessels or craft obstructing or endangering navigation, 637.

Examinations and Surveys.—Menemsha Bight, Mass., 642; Canapitsit Channel, Mass., between the islands of Cuttyhunk and Nashawena, 645.

APPENDIX D.

REPORT OF COL. D. C. HOUSTON, CORPS OF ENGINEERS.

Improvements.—Mystic River, Conn., 650: Thames River, Conn., 652; Connecticut River, Mass. and Conn., 656; harbor of refuge at Duck Island Harbor, Conn., 664; Clinton Harbor, Conn., 667; New Haven Harbor, Conn., 668; breakwaters at New Haven, Conn., 673; Milford Harbor, Conn., 677; Housatonic River, Conn., 680; Bridgeport Harbor, Conn., 685; Black Rock Harbor, Conn., 689; Norwalk Harbor, Conn., 692; harbor at Wilsons Point, Conn., 695; Five-Mile River Harbor, Conn., 697; Stamford Harbor, Conn., 699; Port Chester Harbor, N. Y., 702; Larchmont Harbor, N. Y., 704; Echo Harbor, New Rochelle, N. Y., 706; East Chester Creek, N. Y., 708; Greenport Harbor, N. Y., 711; Port Jefferson Harbor, N. Y., 713; Huntington Harbor, N. Y., 717; Glen Cove Harbor, N. Y., 720; Flushing Bay, N. Y., 722; Patchogue River, N. Y., 724; Browns Creek, Sayville, N. Y., 727.

Harbor Lines.—Five-Mile River Harbor, Conn., 730.

APPENDIX E.

REPORT OF LIEUT. COL. G. L. GILLESPIE, CORPS OF ENGINEERS.

IMPROVEMENTS.—Hudson River, N. Y., 734; harbor at Saugerties, N. Y., 771; harbor at Rondout, N. Y., 773; Wappinger Creek, N. Y., 776; Harlem River, N. Y., 778; East River and Hell Gate, N. Y., 797; Newtown Creek, N. Y., 810; Buttermilk Channel, New York Harbor, 814; Gowanus Bay, Red Hook, Gowanus Creek, and Bay Ridge channels, New York Harbor, N. Y., 817; New York Harbor, N. Y., 824; Raritan Bay, N. J., 833; removing sunken vessels or craft obstructing or endangering navigation, 838

EXAMINATION AND SURVEY.—For canal from Jamaica Bay to Long Beach Inlet, N. Y., 840.

HARBOR LINES.—New York Harbor and its adjacent waters, 849.

APPENDIX F.

REPORT OF CAPT. THOS. L. CASEY, CORPS OF ENGINEERS.

IMPROVEMENTS.—Sumpawanus Inlet, N. Y., 863; Canarsie Bay, N. Y., 866; Sheepshead Bay, N. Y., 868; Arthur Kill, N. Y. and N. J., 869; channel between Staten Island and New Jersey, 871; Passaic River, N. J., 873; Elizabeth River, N. J., 878; Rahway River, N. J., 880; Raritan River, N. J., 881; South River, N. J., 887; Keyport Harbor, N. J., 889; Mattawan Creek, N. J., 890; Shoal Harbor and Compton Creek, N. J., 892; Shrewsbury River, N. J., 894; Manasquan River, N. J., 897.

APPENDIX G.

REPORT OF MAJ. C. W. RAYMOND, CORPS OF ENGINEERS.

IMPROVEMENTS.—Delaware River, Pa. and N. J., 900; harbor between Philadelphia, Pa., and Camden, N. J., 906; Schuylkill River, Pa., 923; ice harbor at Marcus Hook, Pa., 929; ice harbor at head of Delaware Bay, Del., 930; construction of iron pier in Delaware Bay, near Lewes, Del., 931; Delaware Breakwater, Del., 933; Rancocas River, N. J., 935; Alloway Creek, N. J., 937; Maurice River, N. J., 938; removing sunken vessels or craft obstructing or endangering navigation, 940.

EXAMINATION.—For harbor of refuge near mouth of Delaware Bay, 941.

APPENDIX H.

REPORT OF WM. F. SMITH, UNITED STATES AGENT, MAJOR OF ENGINEERS, U. S. ARMY, RETIRED.

IMPROVEMENTS.—Wilmington Harbor, Del., 946; ice harbor at New Castle, Del., 948; Appoquinnimink River, Del., 950; Smyrna River, Del., 951; Mispillion Creek, Del., 953; Broadkiln River, Del., 955; inland waterway from Chincoteague Bay, Va., to Delaware Bay, at or near Lewes, Del., 956; Susquehanna River, above and below Havre de Grace, Md., 966; North East River, Md., 967; Elk River, Md., 968; Fairlee Creek, Md., 969; Chester River, Md., from Crumpton to Jones Landing, 970; Choptank River, Md., 972; Cambridge Harbor, Md., 973; Wicomico River, Md., 975; Manokin River, Md., 976; Onancock Harbor, Va., 977; harbor at Cape Charles City, Va., and approaches by Cherrystone Inlet, 979; removing sunken vessels or craft obstructing or endangering navigation, 980.

EXAMINATIONS AND SURVEYS.—Murderkill River, Del., 981; Mispillion River, Del., 988; Susquehanna River above Havre de Grace, Md., 994; Rock Hall Harbor, Md., 999.

PART II.

APPENDIX I.

REPORT OF COL. WM. P. CRAIGHILL, CORPS OF ENGINEERS.

IMPROVEMENTS.—Patapsco River and channel to Baltimore, Md., 1005; James River, Va., 1012.

APPENDIX J.

REPORT OF MAJ. CHARLES E. L. B. DAVIS, CORPS OF ENGINEERS.

IMPROVEMENTS.—Potomac River at Washington, D. C., 1030; Potomac River at Mt. Vernon, Va., 1038; Occoquan Creek, Va., 1039; Aquia Creek, Va., 1042; harbor at Breton Bay, Md., 1045; Nomini Creek, Va., 1047; Patuxent River, Md., 1049; Rappahannock River, Va., 1050; Urbana Creek, Va., 1054; York River, Va., 1056; Mattaponi River, Va., 1059; Pamunkey River, Va., 1062.

EXAMINATIONS AND SURVEYS.—Eastern Branch of Potomac River (Anacostia River), 1064; Potomac River, Va. and Md., 1069; for breakwater to form harbor of refuge in Lynnhaven Bay, near Cape Henry, Va., 1076.

HARBOR LINES.—Anacostia River at Washington, D. C., 1079.

APPENDIX K.

REPORT OF LIEUT. EDW. BURR, CORPS OF ENGINEERS.

IMPROVEMENTS.—Harbor of Norfolk and its approaches, Va., 1085; approach to Norfolk Harbor and the United States navy-yard at Norfolk, Va., 1089; Hampton Creek and Bar, Va., 1089; Nansemond River, Va., 1090; Chickahominy River, Va., 1091; Appomattox River, Va., 1093; inland water route from Norfolk Harbor, Va., to Albemarle Sound, N. C., through Currituck Sound, 1094; North Landing River, Va. and N. C., 1096.

HARBOR LINES.—South Branch of Elizabeth River at navy-yard, Norfolk, Va., 1097.

APPENDIX L.

REPORT OF MAJ. W. S. STANTON, CORPS OF ENGINEERS.

IMPROVEMENTS.—Staunton River, Va., 1099; Roanoke River, N. C., 1103; Pasquotank River, N. C., 1111; Mackeys Creek, N. C., 1113; Ocracoke Inlet, N. C., 1115; Fishing Creek, N. C., 1117; Pamlico and Tar River, N. C., 1118; Contentnia Creek, N. C., 1123; Trent River, N. C., 1125; Neuse River, N. C., 1129; inland waterway between New Berne and Beaufort, N. C., 1134; harbor at Beaufort, N. C., 1137; inland waterway between Beaufort Harbor and New River, N. C., 1141; waterway between New River and Swansboro, N. C., 1146; New River, N. C., 1149; North East (Cape Fear) River, N. C., 1152; Black River, N. C., 1154; Cape Fear River, N. C., above Wilmington, 1158; Cape Fear River, N. C., at and below Wilmington, 1164; Lockwoods Folly River, N. C., 1177; Yadkin River, N. C., 1181; harbor at Georgetown, S. C., 1183; Winyaw Bay, S. C., 1189; removing sunken vessels or craft obstructing or endangering navigation, 1194.

APPENDIX M.

REPORT OF CAPT. FREDERIC V. ABBOT, CORPS OF ENGINEERS.

IMPROVEMENTS.—Waccamaw River, N. C. and S. C., 1195; Lumber River, N. C. and S. C., 1199; Little Pedee River, S. C., 1201; Great Pedee River, S. C., 1203; Clark River, S. C., 1206; Mingo Creek, S. C., 1208; Santee River, S. C., 1211; Wateree River, S. C., 1214; Congaree River, S. C., 1217; harbor at Charleston, S. C., 1219; Ashley River, S. C., 1229; Wappoo Cut, S. C., 1231; Edisto River, S. C., 1233; Salkahatchie River, S. C., 1235; Beaufort River, S. C., 1238; removing sunken vessels or craft obstructing or endangering navigation, 1240.

APPENDIX N.

REPORT OF CAPT. O. M. CARTER, CORPS OF ENGINEERS.

IMPROVEMENTS.—Savannah Harbor, Ga., 1243; Savannah River, Ga., 1253; Darien Harbor, Ga., 1257; Altamaha River, Ga., 1261; Oconee River, Ga., 1265; Ocmulgee River, Ga., 1271; Brunswick Harbor, Ga., 1278; Jekyl Creek, Ga., 1283; Cumberland Sound, Ga. and Fla., 1286; removing sunken vessels or craft obstructing or endangering navigation, 1292.

EXAMINATIONS AND SURVEYS.—Inside route between Doboy and Sopelo, Ga., 1294; inside route between Savannah, Ga., and Fernandina, Fla., 1309; Brunswick Outer Bar, Ga., 1327.

APPENDIX O.

REPORT OF MAJ. J. C. MALLERY, CORPS OF ENGINEERS.

IMPROVEMENTS.—St. Johns River, Fla., 1319; Ocklawaha River, Fla., 1366; Volusia Bar, Fla., 1369; St. Augustine Harbor, Fla., 1371; northwest entrance, Key West Harbor, Fla., 1374; Caloosahatchee River, Fla., 1377; channel of Charlotte Harbor and Pease Creek, Fla., 1379; Sarasota Bay, Fla., 1382; Manatee River, Fla., 1384; Tampa Bay, Fla., 1386; Withlacoochee River, Fla., 1389; harbor at Cedar Keys, Fla., 1392; Suwanee River, Fla., 1393.

APPENDIX P.

REPORT OF CAPT. PHILIP M. PRICE, CORPS OF ENGINEERS.

IMPROVEMENTS.—Apalachicola Bay, Fla., 1397; Apalachicola River, Fla., 1400; Flint River, Ga., 1402; Chattahoochee River, Ga. and Ala., 1405; La Grange Bayou and Holmes River, Fla., 1407; Choctawhatchee River, Fla. and Ala., 1409; harbor at Pensacola, Fla., 1412; Escambia and Conecuh rivers, Fla. and Ala., 1416; Alabama River, Ala., 1418; Tallapoosa River, Ala., 1422; Coosa River, Ga. and Ala., 1424; operating and care of canals and other works of navigation on Coosa River, Ga. and Ala., 1431; Cahaba River, Ala., 1432.

APPENDIX Q.

REPORT OF MAJ. A. N. DAMRELL, CORPS OF ENGINEERS.

IMPROVEMENTS.—Mobile Harbor, Ala., 1435; Black Warrior River, Ala., from Tuscaloosa to Daniels Creek, 1440; Warrior and Tombigbee rivers, Ala. and Miss., 1444; Noxubee River, Miss., 1452; Pascagoula River, Miss., 1453; Chickasahay River, Miss., 1456; Bluff Creek, Miss., 1457; Leaf River, Miss., 1458; harbor at Biloxi Bay, Miss., 1458; Pearl River, Miss., below Jackson, 1460; Pearl River, Miss., between Jackson and Carthage, 1462; Pearl River, Miss., between Edinburg and Carthage, 1465; Bogue Chitto, La., 1466.

APPENDIX R.

REPORT OF MAJ. JAMES B. QUINN, CORPS OF ENGINEERS.

INSPECTION of the improvement of the South Pass of the Mississippi River, 1469.

APPENDIX S.

REPORT OF MAJ. JAMES B. QUINN, CORPS OF ENGINEERS.

IMPROVEMENTS.—Chefuncte River and Bogue Falia, La., 1481; Tickfaw River and its tributaries, La., 1484; Amite River and Bayou Manchac, La., 1485; Bayou La Fourche, La., 1487; Bayou Terrebonne, La., 1490; Bayou Plaquemine, La., 1491; Bayou Cortableau, La., 1500; Bayou Teche, La., 1503; mouth and passes of Calcasieu River, La., 1504; harbor at Sabine Pass, Tex., 1506; Sabine River, Tex., 1510; Neches River, Tex., 1511; removing sunken vessels or craft obstructing or endangering navigation, 1513.

EXAMINATION.—Sabine River between Sabine Lake and Sudduths Bluff, Tex., 1513.

APPENDIX T.

REPORT OF LIEUT. JOHN MILLIS, CORPS OF ENGINEERS.

IMPROVEMENTS.—Securing mouth of Bayou Plaquemine, La., from further caving, 1517; removing sunken vessels or craft obstructing or endangering navigation in Mississippi River below New Orleans Harbor, La., 1521.

APPENDIX U.

REPORT OF MAJ. CHAS. J. ALLEN, CORPS OF ENGINEERS.

IMPROVEMENTS.—Entrance to Galveston Harbor, Tex., 1523; ship channel in Galveston Bay, Tex., 1535; Trinity River, Tex., 1540; Cedar Bayou, Tex., 1543; Buffalo Bayou, Tex., 1548; harbor at Brazos Santiago, Tex., 1553.

EXAMINATIONS AND SURVEY.—Brazos River, Tex., from its mouth to Waco, 1555; West Galveston Bay from Christmas Point, Tex., 1563.

APPENDIX V.

REPORT OF CAPT. J. H. WILLARD, CORPS OF ENGINEERS.

IMPROVEMENTS.—Red River. La. and Ark., 1573; Red River above Fulton, Ark., 1600; Ouachita and Black rivers, Ark. and La., 1602; Bayou D'Arbonne, La., 1607; Bayou Bartholomew, La. and Ark., 1610; Bayou Bœuf, La., 1614; Tensas River and Bayou Maçon, La , 1617; Bayous Rondeway and Vidal, La., 1620; Big Black River, Miss., 1622; Yazoo River, Miss., 1624; Tchula Lake, Miss., 1645; Tallahatchee River, Miss., 1648; Steele Bayou and Washington Bayou, Miss., 1651; Big Sunflower River, Miss., 1654; Big Hatchee River, Tenn., 1657; Forked Deer River, Tenn., 1660; water gauges on Mississippi River and its principal tributaries, 1663; survey of Cypress Bayou and the lakes between Jefferson, Tex., and Shreveport, La., 1668.

APPENDIX W.

REPORT OF CAPT. H. S. TABER, CORPS OF ENGINEERS.

IMPROVEMENTS.—Removing obstructions in Arkansas River, 1673; Arkansas River, 1676; Fourche Le Fevre River, Ark., 1681; Petit Jean River, Ark., 1682; White River, Ark., 1683; Cache River, Ark., 1687; Little Red River, Ark., 1687; Black River, Ark. and Mo., 1689; Black River, Mo., 1691; St. Francis River, Ark., 1693; St. Francis River, Mo., 1694; Little River, Mo., 1696.

EXAMINATION AND SURVEY.—At Clarendon and the lower White River, Ark., 1697.

APPENDIX X.

REPORT OF MAJ. A. M. MILLER, CORPS OF ENGINEERS.

IMPROVEMENTS.—Removing snags and wrecks from Mississippi River, 1705; Mississippi River, between the Ohio and Illinois rivers, 1713; harbor at St. Louis, Mo. 1737; Gasconade River, Mo., 1739; Osage River, Mo., 1742; Kaskaskia River, Ill., 1745.

APPENDIX Y.

REPORT OF MAJ. A. MACKENZIE, CORPS OF ENGINEERS.

IMPROVEMENTS.—Operating snag boats and dredge boats on Upper Mississippi River, 1749; Mississippi River, between Des Moines Rapids and mouth of Illinois River, 1766; Des Moines Rapids, Mississippi River, 1772; operating and care of Des Moines Rapids Canal and dry dock, 1773; Mississippi River between Minneapolis and Des Moines Rapids, 1779.

APPENDIX Z.

REPORT OF MAJ. W. A. JONES, CORPS OF ENGINEERS.

IMPROVEMENTS.—Mississippi River above Falls of St. Anthony, Minn., 1816; reservoirs at headwaters of Mississippi River, 1818; Chippewa River, including Yellow Banks, Wis., 1833; St. Croix River, Wis. and Minn., 1837; Minnesota River, Minn., 1840; Red River of the North, Minn. and N. Dak., 1843; surveys for reservoirs at the sources of Mississippi, St. Croix, Chippewa, and Wisconsin rivers, 1849; gauging Mississippi River at or near St. Paul, Minn., 1849.

EXAMINATION AND SURVEY.—Red River of the North and tributaries above Fergus Falls and Crookston, Minn., and Big Stone Lake, Minn. and S. Dak., 1853.

APPENDIX A A.

REPORT OF CAPT. CHAS. F. POWELL, CORPS OF ENGINEERS.

IMPROVEMENTS.—Missouri River between the Great Falls, Mont., and Sioux City, Iowa, 1875; Yellowstone River, Mont. and N. Dak., 1903.

EXAMINATION AND SURVEY.—Missouri River, Mont., between Great Falls and cañon next below Stubbs Ferry, 1904.

APPENDIX B B.

REPORT OF LIEUT. COL. HENRY M. ROBERT, CORPS OF ENGINEERS.

IMPROVEMENTS.—Tennessee River, above Chattanooga, Tenn., and below Bee Tree Shoals, Ala., 1911; Hiawassee River, Tenn., 1920; French Broad River, Tenn., 1922; Clinch River, Tenn., 1925; Cumberland River, Tenn. and Ky., 1927; Caney Fork River, Tenn., 1941; South Fork of Cumberland River, Ky., 1943.

APPENDIX C C.

REPORT OF CAPT. GEO. W. GOETHALS, CORPS OF ENGINEERS.

IMPROVEMENTS.—Tennessee River between Chattanooga, Tenn., and foot of Bee Tree Shoals, Ala., 1945; operating and care of Muscle Shoals Canal, Tennessee River, 1956.

PART III.

APPENDIX D D.

REPORT OF MAJ. AMOS STICKNEY, CORPS OF ENGINEERS.

IMPROVEMENTS.—Ohio River, 1960; operating snag boats on Ohio River, 1978; operating and care of Davis Island Dam, Ohio River, 1980; movable dam in Ohio River below mouth of Beaver River, Pa., 1983; Monongahela River, W. Va. and Pa., 1984; operating and care of Locks and Dams Nos. 8 and 9, Monongahela River, 1986; purchase of Lock and Dam No. 7, Monongahela River, 1989; purchase of Lock and Dam No. 6, Monongahela River, 1990; Cheat River, W. Va., 1991; Allegheny River, Pa., 1992; dam at Herr Island, Allegheny River, Pa., 1996; ice harbor at mouth of Muskingum River, Ohio, 1997; operating and care of ice-harbor lock at mouth of Muskingum River, Ohio, 1998; Muskingum River, Ohio, 1999; operating and care of locks and dams on Muskingum River, Ohio, 2000.

APPENDIX E E.

REPORT OF LIEUT. COL. G. J. LYDECKER, CORPS OF ENGINEERS.

IMPROVEMENTS.—Falls of the Ohio River, at Louisville, Ky., 2015; Indiana Chute, Falls of the Ohio River, 2020; operating and care of Louisville and Portland Canal, Ky., 2024; Wabash River, Ind. and Ill., 2031; White River, Ind., 2037.

APPENDIX F F.

REPORT OF COL. WM. P. CRAIGHILL, CORPS OF ENGINEERS.

IMPROVEMENTS.—Great Kanawha River, W. Va., 2041; operating and care of locks and dams on Great Kanawha River, W. Va., 2062; Elk River, W. Va., 2064; Gauley River, W. Va., 2067; New River, Va. and W. Va., 2071.

APPENDIX G G.

REPORT OF MAJ. D. W. LOCKWOOD, CORPS OF ENGINEERS.

IMPROVEMENTS.—Tradewater River, Ky., 2073; operating and keeping in repair locks and dams on Green and Barren rivers, Ky., 2074; Rough River, Ky., 2081; Kentucky River, Ky., 2083; operating and keeping in repair locks and dams on Kentucky River, Ky., 2091; Licking River, Ky., between Farmers and West Liberty, 2097; Big Sandy River, W. Va. and Ky., 2098; Levisa Fork of Big Sandy River, Ky., 2108; Tug Fork of Big Sandy River, W. Va. and Ky., 2109; Guyandotte River, W. Va., 2111; Little Kanawha River, W. Va., 2114; operating and keeping in repair lock and dam on Little Kanawha River, W. Va., 2117; Buckhannon River, W. Va., 2119.

APPENDIX H H.

REPORT OF CAPT. W. L. FISK, CORPS OF ENGINEERS.

IMPROVEMENTS.—Harbor at Grand Marais, Minn., 2121; harbor at Agate Bay, Minn., 2123; harbor at Duluth, Minn., 2126; harbor at Superior Bay and St. Louis Bay, Wis., 2132; Minnesota Point, at Superior, Wis., 2137; harbor at Ashland, Wis., 2137; harbor at Ontonagon, Mich., 2139; Eagle Harbor, Mich., 2141; harbor at Marquette, Mich., 2142; harbor of refuge at Grand Marais, Mich., 2145.

EXAMINATION AND SURVEY.—St. Louis River, Minn. and Wis., from Grassy Point, in St. Louis Bay, to Fond du Lac, 2148.

APPENDIX I I.

REPORT OF MAJ. JAMES F. GREGORY, CORPS OF ENGINEERS.

IMPROVEMENTS.—Portage Lake and Lake Superior canals across Keweenaw Point, Mich., 2158; Manistique Harbor, Mich, 2170; Cedar River Harbor, Mich., 2172; Menominee Harbor, Mich. and Wis., 2173; Menominee River, Mich. and Wis., 2175; Oconto Harbor, Wis., 2177; Pensaukee Harbor, Wis., 2179; Green Bay Harbor, Wis., 2180; harbor of refuge at entrance of Sturgeon Bay Canal, Wis., 2182; Ahnapee Harbor, Wis., 2184; Kewaunee Harbor, Wis., 2187; Two Rivers Harbor, Wis., 2189; Manitowoc Harbor, Wis., 2191; Sheboygan Harbor, Wis., 2194; Port Washington Harbor, Wis., 2196; harbor of refuge at Milwaukee Bay, Wis., 2199; Milwaukee Harbor, Wis., 2201; Racine Harbor, Wis., 2204; Kenosha Harbor, Wis., 2207; Waukegan Harbor, Ill., 2209; Fox River, Wis., 2213; operating and care of locks and dams on Fox River, Wis., 2222.

APPENDIX J J.

REPORT OF CAPT. W. L. MARSHALL, CORPS OF ENGINEERS.

IMPROVEMENTS.—Chicago Harbor, Ill., 2237; Calumet Harbor, Ill., 2245; Calumet River, Ill. and Ind., 2249; Illinois River, Ill., 2255; operating and care of La Grange Lock and Dam, Illinois River, Ill., 2294; Illinois and Mississippi Canal, 2297.

APPENDIX K K.

REPORT OF MAJ. WILLIAM LUDLOW, CORPS OF ENGINEERS.

IMPROVEMENTS.—Petoskey Harbor, Mich., 2314; Charlevoix Harbor and entrance to Pine Lake, Mich., 2315; Frankfort Harbor, Mich., 2318; harbor of refuge at Portage Lake, Mich., 2320; Manistee Harbor, Mich., 2322; Ludington Harbor, Mich., 2326; Pentwater Harbor, Mich., 2328; White River Harbor, Mich., 2331; Muskegon Harbor, Mich., 2333; Grand Haven Harbor, Mich., 2340; Holland Harbor, Mich., 2348; Saugatuck Harbor, Mich., 2350; South Haven Harbor, Mich., 2353; St. Joseph Harbor, Mich., 2357; St. Joseph River, Mich., 2363; Michigan City Harbor, Ind., 2365.

EXAMINATION AND SURVEY.—Grand River, Mich., below Grand Rapids, 2369.

APPENDIX L L.

REPORT OF COL. O. M. POE, CORPS OF ENGINEERS.

Improvements.—St. Marys River, Mich., 2398; operating and care of St. Marys Falls Canal, Mich., 2426; dry dock at St. Marys Falls Canal, Mich., 2443; Hay Lake Channel, St. Marys River, Mich., 2443; harbor at Cheboygan, Mich., 2448; harbor at Thunder Bay, Mich., 2450; Thunder Bay River, Mich., 2452; harbor at Au Sable, Mich., 2453: Saginaw River, Mich., 2454; harbor of refuge at Sand Beach, Lake Huron, Mich., 2464; Black River, at Port Huron, Mich., 2469; mouth of Black River, Mich., 2471; St. Clair Flats Canal, Mich., 2473; operating and care of St. Clair Flats Canal, Mich, 2475; Clinton River, Mich, 2477; Grosse Pointe Channel, Mich., 2478; Rouge River, Mich., 2480; Detroit, River, Mich., 2481; removing sunken vessels or craft obstructing or endangering navigation, 2483.

APPENDIX M M.

REPORT OF LIEUT. COL. JARED A. SMITH, CORPS OF ENGINEERS.

Improvements.—Monroe Harbor, Mich., 2486; Toledo Harbor, Ohio, 2487; Port Clinton Harbor, Ohio, 2494; Sandusky City Harbor, Ohio, 2495; Sandusky River, Ohio, 2497; Huron Harbor, Ohio, 2498; Vermillion Harbor, Ohio, 2500; Black River Harbor, Ohio, 2501; Cleveland Harbor, Ohio, 2503; Fairport Harbor, Ohio, 2506; Ashtabula Harbor, Ohio, 2508; removing sunken vessels or craft obstructing or endangering navigation, 2510.

Examinations and Surveys.—Grand River, Ohio, between Richmond and the mouth, 2511; Conneaut Harbor, Ohio, 2515.

APPENDIX N N.

REPORT OF MAJ. E. H. RUFFNER, CORPS OF ENGINEERS.

Improvements.—Erie Harbor, Pa., 2522; preservation and protection of Presque Isle Peninsula, Erie Harbor, Pa., 2526; Dunkirk Harbor, N. Y., 2527; Buffalo Harbor, N. Y., 2529; Tonawanda Harbor and Niagara River, N. Y., 2533; Wilson Harbor, N. Y., 2534; Olcott Harbor, N. Y., 2536; Oak Orchard Harbor, N. Y., 2537.

Examination and Survey.—Port Day, above Niagara Falls, N. Y., 2539.

APPENDIX O O.

REPORT OF CAPT. DAN C. KINGMAN, CORPS OF ENGINEERS.

Improvements.—Harbor at Charlotte, N. Y., 2551; harbor at Pultneyville, N. Y., 2557; harbor at Great Sodus Bay, N. Y., 2564; harbor at Little Sodus Bay, N. Y., 2572; harbor at Oswego, N. Y., 2581; harbor at Sacketts Harbor, N. Y., 2597.

APPENDIX P P.

REPORT OF MAJ. M. B. ADAMS, CORPS OF ENGINEERS.

Improvements.—Shoals between Sister Islands and Crossover Light, St. Lawrence River, N. Y., 2599; Ogdensburg Harbor, N. Y., 2601; breakwater at Rouse Point, Lake Champlain, N. Y., 2604; Great Chazy River, N. Y., 2605; breakwater at Gordon Landing, Lake Champlain, Vt., 2606; Plattsburg Harbor, N. Y., 2607; Burlington Harbor, Vt., 2609; Otter Creek, Vt., 2612; Ticonderoga River, N. Y., 2613; Narrows of Lake Champlain, N. Y. and Vt., 2614.

APPENDIX Q Q.

REPORT OF COL. G. H. MENDELL, CORPS OF ENGINEERS.

Improvement.—Oakland Harbor, Cal., 2617.

APPENDIX R R.

REPORT OF LIEUT. COL. W. H. H. BENYAURD, CORPS OF ENGINEERS.

Improvements.—Napa River, Cal., 2622; Redwood Creek, Cal., 2623; San Luis Obispo Harbor, Cal., 2624; Wilmington Harbor, Cal., 2626; San Diego Harbor, Cal., 2628.
Examination.—For deep-water harbor on Pacific coast between Points Dume and Capistrano, Cal., 2630.
Harbor Lines.—Wilmington Harbor, Cal., 2638; San Diego Harbor and adjacent waters, Cal., 2640.

APPENDIX S S.

REPORT OF MAJ. W H. HEUER, CORPS OF ENGINEERS.

Improvements.—San Joaquin River, Cal., 2645; Mokelumne River, Cal., 2651; Sacramento and Feather rivers, Cal., 2652; Petaluma Creek, Cal., 2655; Humboldt Harbor and Bay, Cal., 2656.

APPENDIX T T.

REPORT OF CAPT. THOMAS W. SYMONS, CORPS OF ENGINEERS.

Improvements.—Coquille River, Oregon, 2662; entrance to Coos Bay, Oregon, 2669; Umpqua River, Oregon, 2679; mouth of Siuslaw River, Oregon, 2681; entrance to Yaquina Bay, Oregon, 2694; Tillamook Bay and Bar, Oregon, 2701; entrance to harbor at Nehalem Bay, Oregon, 2703; Upper Columbia and Snake rivers, Oregon and Wash., 2709; Columbia River between head of Rock Island Rapids and foot of Priest Rapids, Wash., 2716; Chehalis River, Wash., 2726; Skagit, Stillaguamish, Nooksack, Snohomish, and Snoqualmie rivers, Wash., 2729.
Examinations and Surveys.—Olympia Harbor, Wash., 2733; Tillamook Bay and Bar, Oregon, 2742; Swinomish Slough, Wash, 2752; ship canal to connect Lakes Union, Washington, and Samamish, with Puget Sound, Wash., 2762.
Harbor Lines.—Olympia Harbor, Vancouver Harbor, and Bellingham Bay, Wash., 2794.

APPENDIX U U.

REPORT OF MAJ. THOS. H. HANDBURY, CORPS OF ENGINEERS.

Improvements.—Mouth of Columbia River, Oregon and Wash., 2808; canal at the Cascades, Columbia River, Oregon, 2819; Columbia and lower Willamette rivers below Portland, Oregon, 2829; Willamette River above Portland, Oregon, 2835; Cowlitz River, Wash., 2837; Youngs and Klaskanine rivers, Oregon, 2839; gauging waters of Columbia River, Oregon and Wash., 2839.
Examinations and Surveys.—Willamette River, Oregon, at Clackamas Rapids, Ross Island, and Corvallis, 2840; lower Willamette and Columbia rivers, below Portland, Oregon, 2850; Columbia River, near Vancouver, Wash., 2865.
Harbor Lines.—Portland Harbor, Oregon, 2869.

APPENDIX V V.

REPORT OF CAPT. FREDERICK ROGERS, UNITED STATES NAVY.

Supervision of the harbor of New York, 2879; correspondence relating to dumping of ballast off Sandy Hook, 2882.

PART IV.

APPENDIX W W.

REPORT OF THE MISSISSIPPI RIVER COMMISSION.

C. B. COMSTOCK, Colonel, Corps of Engineers, Bvt. Brig. Gen., U. S. A., President; CHARLES R. SUTER, Lieutenant-Colonel, Corps of Engineers, U. S. A.; O. H. ERNST, Major, Corps of Engineers, Colonel, U. S. A.; HENRY L. WHITING, Assistant U. S. Coast and Geodetic Survey; B. M. HARROD, ROBERT S. TAYLOR, and HENRY FLAD, *Commissioners.*

ANNUAL REPORT FOR FISCAL YEAR ENDING JUNE 30, 1892, 2887.

APPENDIX 1.—Report of Lieut. Col. Charles R. Suter, Corps of Engineers, on effects of Ames Crevasse, March 16, 1891, 2905.

APPENDIX 2.—Report of Lieut. Col. Charles R. Suter, Corps of Engineers, on velocity of flood travel on lower Mississippi River, 2905.

APPENDIX 3.—Report of Capt. S. W. Roessler, Corps of Engineers, on survey of Nonconnah Rocks, 2913.

APPENDIX 4.—Report of Capt. Carl F. Palfrey, Corps of Engineers, Secretary Mississippi River Commission, 2914; (A) report of Assistant Engineer Chas. W. Stewart on secondary triangulation from Keokuk to Port Louisa, Iowa, etc., 2932; (B) report of Assistant Engineer O. W. Ferguson on field work and reduction of precise levels from St. Paul, Minn., to Savanna, Ill., etc., 2946; (C) report of Assistant Engineer Jas. A. Paige on precise levels from Duluth to St. Paul, Minn., etc., 3074; (D) report of Assistant Engineer F. B. Maltby on topographical and hydrographical field work from Alton, Ill., to Hannibal, Mo., 3105; (E) report of Assistant Engineer A. T. Morrow on caving banks and condition of survey marks from Cairo, Ill., to Donaldsonville, La., 3109; (F) report of Assistant Engineer J. A. Ockerson on caving banks from Cairo to Donaldsonville, etc., 3110; (H) discharge measurements on Mississippi, Ohio, and Atchafalaya rivers, and crevasse and overflow measurements, 1891, 3118; (I) low waters of 1891 surpassing former records, 3144.

APPENDIX 5.—Report of Capt. S. W. Roessler, Corps of Engineers, on operations in first and second districts, 3145; (A) report of assistant engineer Aug. J. Nolty on operations at Plum Point Reach, 3152; (B) report of assistant engineer W. M. Rees on operations in Hopefield Bend, Ark., 3161; (C) report of assistant engineer C. W. Sturtevant on repairs to plant, 3163; abstracts of bids, financial statements, etc., 3165.

APPENDIX 6.—Report of Capt. C. McD. Townsend, Corps of Engineers, on operations in third district, 3170.

APPENDIX 7.—Report of Lieut. John Millis, Corps of Engineers, on operations in fourth district, 3207.

APPENDIX X X.

REPORT OF THE MISSOURI COMMISSION.

CHAS. R. SUTER, Lieutenant-Colonel, Corps of Engineers, U. S. A., President; A. MACKENZIE, Major, Corps of Engineers, U. S. A.; O. H. ERNST, Major, Corps of Engineers, Colonel, U. S. A.; GARLAND C. BROADHEAD and R. S. BERLIN, *Commissioners.*

ANNUAL REPORT FOR FISCAL YEAR ENDING JUNE 30, 1892, 3251.

APPENDIX A.—Annual report of the Secretary Missouri River Commission, 3259; (1) commerce of the Missouri River during 1891, 3262; (2) elevations of surface of ground at secondary triangulation stations between Three Forks and Fort Benton, Mont., 3270; (3) annual report of Mr. A. H. Blaisdell, assistant engineer, 3271; (4) annual report of Mr. J. A. Seddon, assistant engineer, 3273.

APPENDIX B.—Annual reports of Mr. Charles F. Potter, division engineer, 3273, 3274.

APPENDIX C.—Annual report of Mr. S. Waters Fox, division engineer, 3278.

APPENDIX D.—Annual report of Mr. Samuel H. Yonge, division engineer, 3290.

APPENDIX Y Y.

BRIDGING NAVIGABLE WATERS OF THE UNITED STATES.

REPORT of Board of Engineers on proposed bridge of city of Duluth, Minn., across canal at entrance of Duluth Harbor, 3315; report of Board of Engineers on proposed bridges of city of Portland, Oregon, across Willamette River at Burnside and Knight-Quimby streets, 3323.

APPENDIX Z Z.

OCCUPANCY OF AND INJURY TO PUBLIC WORKS BY CORPORATIONS AND INDIVIDUALS.

(1) REPORT of Capt. Thomas L. Casey, Corps of Engineers, 3341; (2) report of Col. William P. Craighill, Corps of Engineers, 3342; (3) report of Maj. Charles E. L. B. Davis, Corps of Engineers, 3344; (4) report of Maj. William Ludlow, Corps of Engineers, 3344; (5) report of Col. O. M. Poe, Corps of Engineers, 3345; (6) report of Capt. Dan C. Kingman, Corps of Engineers, 3347.

APPENDIX A A A.

REPORT OF LIEUT. COL. GEORGE H. ELLIOT, CORPS OF ENGINEERS.

WASHINGTON AQUEDUCT, 3349; water supply, District of Columbia, 3380; increasing the water supply of Washington, D. C., 3381; erection of fishways at Great Falls, 3382.

APPENDIX B B B.

REPORT OF COL. O. H. ERNST, UNITED STATES ARMY.

IMPROVEMENT and care of public buildings and grounds in the District of Columbia, Washington Monument, 3385.

APPENDIX C C C.

SURVEY OF THE NORTHERN AND NORTHWESTERN LAKES.

ISSUE of published charts of the northern and northwestern lakes, and surveys made for the purpose of keeping these charts up to date, 3407; survey of Waverly Shoal, Lake Erie, 3424; survey of shoals in St. Lawrence River, N. Y., (1) Haskell Shoal, 3425; (2) shoals near Crossover Light, 3426; resurvey of the lake front at Chicago, 3427; survey of Black Creek Shoal, Lake Ontario, 3428; annual water-level curves of the northern and northwestern lakes, 3429.

APPENDIX D D D.

REPORT OF MAJ. WILLIAM A. JONES, CORPS OF ENGINEERS.

CONSTRUCTION and improvement of roads and bridges in the Yellowstone National Park, 3433.

APPENDIX E E E.

EXPLORATIONS AND SURVEYS IN MILITARY DEPARTMENTS.

REPORT of Lieut. Cassius E. Gillette, Corps of engineers, engineer officer, on operations in Department of the Missouri, 3457; report of Maj. Tully McCrea, Fifth Artillery, acting engineer officer, on operations in Department of the Columbia, 3458; report of Capt. Charles A. Worden, Seventh Infantry, acting engineer officer, on operations in Department of the Platte, 3459; report of Lieut. Charles G. Lyman, Second Cavalry, in charge of office, on operations in Department of California, 3459.

LAWS AFFECTING THE CORPS OF ENGINEERS, FIFTY-SECOND CONGRESS, FIRST SESSION, 1891-'92 3461

ANNUAL REPORT

OF THE

CHIEF OF ENGINEERS,

UNITED STATES ARMY.

1892.

REPORT

OF

THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., September 30, 1892.

SIR: I have the honor to present for your information the following report upon the duties and operations of the Engineer Department for the fiscal year ending June 30, 1892:

OFFICERS OF THE CORPS OF ENGINEERS.

The number of officers holding commissions in the Corps of Engineers, U. S. Army, at the end of the fiscal year was 117.

Since the last annual report the corps has lost one of its officers, Lieut. Col. William E. Merrill, who died on December 14, 1891.

There were added to the corps, by promotion of graduates of the Military Academy, five additional second lieutenants.

On the 30th of June, 1892, the officers were distributed as follows:

Commanding the Corps of Engineers and the Engineer Department	1
Office of the Chief of Engineers	3
Board of Engineers, fortifications, river and harbor works, and Division Engineer	1
Board of Engineers, Board of Ordnance and Fortification, and Division Engineer	1
Fortifications, river and harbor works, and Division Engineers	2
Board of Engineers, Mississippi River Commission, Division Engineer, and Board of Visitors	1
Board of Engineers, fortifications, river and harbor works, and Board of Visitors	2
Washington Aqueduct and Light-House Board	1
River and harbor works	33
Fortifications and river and harbor works	30
Mississippi River Commission and Missouri River Commission	1
Fortifications, Post of Willets Point, U. S. Engineer School, and Battalion of Engineers	1
River and harbor works and Missouri River Commission	1
Public buildings and grounds, Mississippi River Commission, Missouri River Commission, and Light-House Board	1
Battalion of Engineers and U. S. Engineer School	14
Mississippi River Commission	1
Fortifications	1
Missouri River Commission	1
Leave of absence	1
Detached, at Military Academy, on International Boundary Commission, with Light-House Establishment, as military attachés, with Board of Commissioners of the District of Columbia, and at headquarters military department	20
	117

The officers detached were on duty as follows:

Lieut. Col. John M. Wilson, Superintendent Military Academy	1
Lieut. Col. John W. Barlow and Lieut. David DuB. Gaillard, Members of International Boundary Commission	2
Maj. David P. Heap, engineer third light-house district	1
Maj. William R. Livermore, engineer first and second light-house districts	1
Maj. James C. Post, military attaché to the United States legation at London	1
Capt. Edward Maguire, engineer fourth light-house district	1
Capt. Frederick A. Mahan, engineer secretary of the Light-House Board	1
Capt. Eric Bergland, engineer fifth and sixth light-house districts	1
Capt. William T. Rossell, Engineer Commissioner of the District of Columbia	1
Capts. James L. Lusk and Gustav J. Fieberger, assistants to the Engineer Commissioner of the District of Columbia	2
Capt. George McC. Derby, and Lieuts. Mason M. Patrick and Charles H. McKinstry, on duty with Company E, Battalion of Engineers, and at Military Academy	3
Capt. Theodore A. Bingham, military attaché to the United States legation at Berlin	1
Lieuts. Harry F. Hodges, Lansing H. Beach, and Joseph E. Kuhn, on duty at Military Academy	3
Lieut. Cassius E. Gillette, engineer officer department of the Missouri	1
	20

FORTIFICATIONS.

The construction of fortifications for the defense of the seacoast was resumed in consequence of $1,221,000 having been appropriated for that purpose by the act of August 18, 1890. For the previous fifteen years no appropriations for this object had been made. By the act approved February 24, 1891, $750,000 was appropriated for the same purpose.

These two appropriations have been allotted to the construction of emplacements for modern rifled guns and mortars for the defense of localities as follows:

Boston:	
Three 10-inch guns	$156,194.05
Sixteen 12-inch mortars	121,039.27
New York:	
Eastern entrance—	
Two 10-inch guns and one 8-inch gun	207,849.25
Sixteen 12-inch mortars	130,000.00
Southern entrance—	
Two 12-inch guns	283,000.00
Three 8-inch guns	189,500.00
Sixteen 12-inch mortars	201,000.00
Washington:	
Two 10-inch guns	117,150.00
Hampton Roads:	
Two 10-inch guns	158,848.00
San Francisco:	
Three 12-inch guns and three 10-inch guns	397,332.00
Unallotted	9,087.43
	1,971,000.00

It was at first contemplated to mount in these emplacements guns of different calibers from those now reported, the intention being to provide emplacements for guns as manufactured. But funds not having been appropriated to provide for emplacements being constructed as rapidly as guns, it will be possible to mount in the emplacements built the guns for which they were originally designed.

The projected fortifications and the progress made in their construction are as follows:

Boston Harbor, Massachusetts.—Officer in charge, Lieut. Col. S. M. Mansfield, Corps of Engineers, with Capt. S. S. Leach, Corps of Engineers, under his immediate orders.

The approved project for the defense of this harbor contemplates, for the present, an armament of twelve 12-inch guns on lifts, fifteen 10-inch and five 8-inch guns on disappearing carriages, one hundred and twenty-eight 12-inch mortars, and submarine mines to be operated from four mining casemates.

During the year the concrete masonry of one 10-inch gun position has been completed on an average to the crown of the arches forming the service magazine and shell room. In the two other gun emplacements operations have been confined to the demolition of old masonry, the removal of earth embankments, and the preparation of foundations for the new masonry. Large quantities of concrete material are being collected.

The entire excavation for the masonry of the mortar battery was completed, and in doing this about 8,000 cubic yards of gravel for concrete was obtained and 9,000 cubic yards of embankment built; 6,700 cubic yards of concrete was put in place, thus completing the masonry of the two rear pit walls, the intervening chambers, the central magazines, and connecting passages.

New York Harbor, New York.—Officers of the Corps of Engineers in charge: Col. D. C. Houston, Lieut. Col. G. L. Gillespie, with First Lieut. Harry Taylor under his immediate orders until August 12, 1891, and First Lieut. James G. Warren since that date, and Lieut. Col. W. R. King.

The projects for the defenses of both the southern and eastern entrances to this harbor contemplate, for the present, an armament of nineteen 12-inch guns on lifts, seventeen 10-inch and nine 8-inch guns on disappearing carriages, one hundred and seventy-six 12-inch mortars, and submarine mines operated from five mining casemates.

Colonel Houston reports as to the three emplacements for 8-inch guns, that about 7,600 cubic yards of earth has been excavated and placed in embankment, 8,485 cubic yards of concrete has been made and placed, stone has been cut out and set for magazine-door fittings, and the construction of doors commenced.

The concrete cover of magazines and guns of two positions has been practically completed except a section in front of the pintles, left vacant temporarily. The concrete work of the third position is about one-third completed, and the earthwork in front of the concrete of the third position is over half built.

Increased storage and wharfage have been provided.

Relative to the construction of the gun battery for two 12-inch guns and one mortar battery, Lieutenant Colonel Gillespie reports:

The construction of the concrete masonry for the gun-lift battery was continued throughout the year, except when suspended from December 23, 1891, to April 13, 1892, on account of cold weather.

At the close of the fiscal year the masonry of the battery had been carried to an average height of 32 feet above the bed of the foundations, or to reference (39.0); the sand core between the exterior 20-foot wall and the interior 10-foot wall had been filled and compacted. The settlement was done by use of water and averaged about 15 per cent.

The total amount of masonry constructed during the year was 29,875.5 cubic yards; that previously reported was 3,055 cubic yards, making the total to June 30, 1892, 32,930.5 cubic yards. There remain to be constructed 10,167.5 cubic yards of masonry; 76 per cent of the masonry construction is therefore completed.

The masonry consists of 23,815 cubic yards of concrete, mixed and placed, at $4.13 per cubic yard, and 5,512 cubic yards of large stone, delivered and placed, at $3.31 per cubic yard, the average cost of the two combined during the year, being $3.91, and the average cost of all the masonry laid, from the beginning, being $5.51, inclusive of superintendence, purchase and maintenance of plant, repairs to buildings, office expenses, and general work.

The contract for the mechanism of the northwest lift was practically completed June 30, 1892, at which date all the parts of the mechanism had been completed, delivered, and set in place, except the final adjustment of the ammunition lift and rammer. A test had been made of the connections to the accumulators, resulting in the satisfactory raising of the accumulators. The final test of the mechanism, with its ultimate load of gun and carriage, will be made in August.

The estimated total cost of a completed battery of this type, accommodating two guns, is $457,000 (not including cost of armament), of which $283,000 is applied to masonry and sand covering, and $174,000 to the mechanism of two gun lifts.

Special modifications of the original plans of the gun-lift battery have been approved, which provide for a defensible entrance and for additional security against attack by boat parties on front and flanks.

A building for office purposes was erected at a total cost of $1,548, and a frame building for the general use of the Engineer Department is in process of construction, by contract, at a cost of $5,000.

At the close of the fiscal year the concrete masonry of the mortar battery was completed, excepting the floors of the magazines and passages, the sloping concrete surface capping for restricting damages by blasts in the pits, the retaining walls, and the counterscarp wall and galleries.

The line of the ditch was cleared of undergrowth and stumps and graded ready for the foundation of the counterscarp wall.

There were constructed 13,025 cubic yards of concrete, at an average cost of $5.28 per cubic yard, including superintendence, purchase and maintenance of plant, repairs to buildings, and general work not capable of specification. No sand has been moved, except when required to prepare for laying of masonry. The total estimated cost of the battery, without armament, is $201,000.

Concerning the construction of emplacements for two 10-inch and one 8-inch guns, Lieutenant Colonel King reports:

Steam hoisting engines and derricks have been placed upon the wharf so that two or even three boats may discharge their cargoes at the same time. A new winding engine has been placed at the head of the incline, of sufficient power to haul heavily loaded cars from the bottom to top in less than one minute, and a small locomotive has been built for handling them when they reach the upper level.

The work of preparing emplacements for two 10-inch and one 8-inch rifles has been continued during the year; one magazine and part of the parapet connecting it with the next emplacement have been completed, and the second magazine is well under way. The earth excavation and concrete work and receiving materials have been carried along together as circumstances would permit, and the daily output of concrete in place has in one case reached 160 cubic yards with a single mixer. This, however, is far above the average, as there are many delays in moving machinery, preparing centers, etc.

The entire quantities of work done on the battery during the year have been as follows, viz:

	Cubic yards.
Earth excavation	10,897
Concrete in place	7,676
Earth embankment	6,346

As to the construction of a mortar battery Lieutenant Colonel King reports:

The buildings for storehouse, office, and blacksmith's shop were completed and derricks and steam drills were kept at work during the year when the weather would permit. Cars and track were bought, and a substantial wharf, with an incline connecting it with the battery, was completed.

A suitable stationary engine was procured and set up at the head of the incline for handling cement, sand, and other heavy materials that will be required in the construction of the battery.

The earth excavation for all the mortar pits and magazines and passages was completed, excepting a part of one mortar pit, and nearly all of this earth and some of the rock was placed in embankment where it will not have to be removed again.

The rock excavation, which is the most serious item of the work required, has also been pushed during the year, and nearly all that required to be removed from two mortar pits and all of the magazines and passageways has been removed and a third pit is partly excavated.

The condition of the work is now such that the concrete work can be commenced at once, and a stone crusher will be set at work at an early day to supply the broken stone. There is enough stone on the ground that has been taken from the pits to supply all the stone needed for concrete on the entire work, and it can be crushed for a mere fraction of what it would cost to buy the stone already broken.

The entire quantities of materials removed during the year are the following, viz:

Rock blasted and removed	cubic yards	3,917
Earth excavated and placed in embankment	do	3,462
Track laid	linear feet	370
Drain laid	do	500

Washington, District of Columbia.—Officers of the Corps of Engineers in charge: Lieut. Col. Peter C. Hains, until November 23, 1891; then Maj. Lewis C. Overman, until December 7, 1891; then Capt. Thomas Turtle, until January 25, 1892, and since that date Maj. Charles E. L. B. Davis, with first Lieut. George A. Zinn under their immediate orders; Division Engineer, Col. William P. Craighill, Corps of Engineers, from January 5, 1892.

The approved project of defense contemplates emplacements for four 12-inch guns on lifts, six 10-inch and three 8-inch guns on disappearing carriages, eight 12-inch mortars, and submarine mines operated from two mining casemates. A project for the construction of emplacements for two 10-inch guns was approved July 11, 1891. In July and August, 1891, preparations for the work were made, plans were prepared, and the collection of a plant begun and, in September, 1891, active operations were commenced.

The site of the emplacement being 125 feet above the river, an extensive plant for handling and delivering material at the site of the work had to be constructed. A new wharf was built, 210 feet long, extending to 17 feet at low water, and provided with four derricks and a hoisting engine. An inclined railway was built up to the top of the hill where a large hoisting engine was placed. Bins for storage and high trestle tracks were constructed, and the necessary cars and machinery purchased. A pump and pipe connections for water supply of boilers and concrete mixer from the river were provided. At the close of the fiscal year ending June 30, 1892, the excavation was practically completed.

Hampton Roads, Virginia.—Under charge of the officers in charge of defenses of Washington, D. C.

The approved project of defense contemplates, for the present, five 12-inch guns on lifts, ten 10-inch guns on disappearing carriages, thirty-two 12-inch mortars, and submarine mines operated from two mining casemates. At the close of the fiscal year ending June 30, 1891, a project for emplacements for two 10-inch guns had been approved and work commenced. The track for steam railway had been extended, a bridge across the ditch and storage bins for concrete material built, a concrete mixer with its necessary plant installed, and a telephone line established between all parts of the work. In October, 1891, the removal of the old redoubt with its concrete gun platforms and magazines was commenced and proved a difficult and expensive piece of work. In March, 1892, the mixing and laying of concrete were commenced.

San Francisco Harbor, California.—Officer in charge, Col. George H. Mendell, Corps of Engineers, with First Lieuts. Henry C. Newcomer and Charles L. Potter, Corps of Engineers, under his immediate orders, the latter until July 28, 1891.

The approved project of defense contemplates, for the present, eighteen 12-inch guns on lifts, twenty-three 10-inch and thirteen 8-inch guns on disappearing carriages; fifteen 12-inch, five 10-inch, and six 8-inch guns on nondisappearing carriages; one hundred and forty-four 12-inch mortars, and submarine mines operated from seven mining casemates. During the year estimates and working drawings for four emplacements were submitted. Of these one was for a disappearing and three for nondisappearing guns. Wharfage and storage facilities and the water supply were increased. Of the rock used, part was obtained from a Government quarry and part by contract at 89 cents per ton of 2,000 pounds.

The excavation necessary for the six emplacements for three 12-inch and three 10-inch guns was completed. The concrete work of three has been completed as far as it can be now done. Excepting the gaps left in the parapets in front of the three gun positions, the masonry is ready for the 3-inch top layer of bituminous rock. Almost 20,000 cubic yards of concrete have been placed in position, and necessary drains have been placed. Much back filling has been executed.

The final completion of all emplacements for guns must await definite information as to the position and the details of gun platforms for carriages, which can not be had until the models for carriages are adopted.

Estimates are submitted for emplacements for six 12-inch, eight 10-inch, and four 8-inch guns, and for one mortar battery.

Balances on hand from previous appropriations should not be considered as justifying any reduction of these estimates, as these balances pertain to works entirely distinct from those for which estimates are now submitted.

MINING CASEMATES.

During the past fiscal year three mining casemates have been completed, forming part of the defenses of Washington, D. C., Hampton Roads, and San Francisco; one for the defense of Portland, Me., is expected to be completed in about six weeks; two for the defense of Philadelphia, for which allotments were made June 8 and October 10, 1891, will be completed during the present working season, and one at Charleston, S. C., is near completion. Working drawings and estimates of cost of two mining casemates for the defense of Narragansett Bay are about ready to be submitted.

The defenses proposed for the places named and for Boston include twelve mining casemates, in addition to those completed or under way, and an estimate is submitted for $150,000, in order that the construction of six of these may be undertaken.

Two special storage sheds for submarine-mining material have been completed at New York and San Francisco, and a third required at the former place will be commenced as soon as the site can be graded and prepared.

SITES FOR FORTIFICATIONS.

The act of August 18, 1890, authorized the acquisition by condemnation, purchase, or donation of sites needed for fortifications. By this act and that of February 24, 1891, $1,000,000 was appropriated for this purpose.

In the fiscal year 1891 the greater portion of sites for one 3-gun battery and two mortar batteries at Grovers Cliff, near Boston, about 50 acres, had been acquired. The title to small portions of these sites, not then acquired, has since been passed upon, and the Attorney-General has been requested to initiate condemnation proceedings for some few lots which it has not been practicable to purchase. The sum of $7,045 was obtained by selling at auction buildings which it was necessary to remove from the site of the mortar battery.

At the southern entrance of New York Harbor places selected as sites for fortifications owned by private parties were located at Coney Island, Fort Hamilton, and Bayside (near Keansburg), N. J.

After examination of the site proposed at Coney Island a new site was selected on Plumb Island, immediately in rear of the eastern end of Coney Island.

Failing to purchase the lands referred to near Fort Hamilton and on Plumb Island at reasonable and equitable rates, proceedings were instituted by the Attorney-General, at the request of the Secretary of War, for condemning the lands in the United States courts.

The decree of the court was rendered in the case of the land on Plumb Island July 7, 1891, and the total amount paid for 50 acres to the owners under the decree was $99,547.76.

After properly recording them, the papers in the case were filed with the Chief of Engineers December 26, 1891.

In the case of lands near Fort Hamilton, 56.54 acres, the decree was rendered November 18, 1891, and the amount paid owners was $292,315.86. The Treasury Department paid, in addition, the sum of $10,452.27 for expenses incurred by the United States district attorney, making the total cost of the land $302,768.13.

The land near Keansburg, N. J., 25.3 acres, was purchased, on authority of the Secretary of War, by agreement, September 11, 1891, at $200 per acre, and the title papers were approved by the Attorney-General of the United States June 6, 1892. Payment will be made in July.

Other sites at this entrance lie west and southwest from the Fort Wadsworth reservation, and amount to about 129 acres. Fourteen acres, with improvements thereon, were purchased for $110,000, its value, as appraised by an expert employed by the Government. Condemnation proceedings have been initiated for the acquisition of other portions of this property.

At Sheridans Point, below Washington, D. C., on the Potomac River, the purchase was authorized of 291 acres of land at a cost not exceeding $65 per acre. But as the owners declined to sell at this figure, condemnation proceedings for the acquisition of 90 acres of this tract were instituted. The resulting award was $140 per acre. This was so much in excess of what was considered a fair price that the appraisement was not accepted. Further proceedings in this case are not now pending.

At Willoughby Point, Virginia, a site for a mortar battery, containing about 47 acres, and two rights of way were condemned; the award, which was accepted, was $23,500. The expenses attending this acquisition were $766.85. This land had been once offered to the Government for $1,000, and later for $500 per acre. Jurisdiction has not been ceded over the sites acquired in New York and New Jersey.

At Point Lobos, California, condemnation proceedings in the case of 54.05 acres approached completion.

It is thought that the unallotted balance of existing appropriations will hardly suffice for the acquisition of sites whose condemnation has been requested; and as it is estimated that nearly 1,900 acres should be acquired at different localities on the coast, an estimate of $500,000 is submitted, which amount can well be applied to this purpose.

Statement of funds pertaining to the acquisition of sites.

APPROPRIATED.

Act of August 18, 1890	$500,000.00
Act of February 24, 1891	500,000.00
	1,000,000.00

ALLOTMENTS.

Portland Harbor, Me., Portland Head:			
1892, May 31. Fees of district attorney for examining title			$100.00
Boston Harbor, Mass.:			
1890, November 22. For expert services, etc		$1,000.00	
Site for mortar batteries, Grovers Cliff:			
1890, December 1. For purchase of land		163,054.12	
Site for gun batteries, Grovers Cliff:			
1890, December 17. For purchase of land		109,583.10	273,637.22
New York Harbor (eastern entrance):			
1892, April 5. For services of real-estate expert		250.00	
Site for mortar battery, Sands Point:			
1891, April 28. For purchase of land (withdrawn)		4,750.00	5,000.00
New York harbor (southern entrance):			
1890, December 12. For services of real-estate expert		1,000.00	
Site adjoining Fort Hamilton 56.54 acres:			
1892, January 26. For purchase of land	$283,000.00		
1892, January 28. For purchase of land	10,000.00		
1892, June 23. Account district attorney and court expenses, etc	10,452.27	303,452.27	

New York harbor (southern entrance)—Continued.					
Site for mortar batteries, Plumb Island:					
1891, August 26. For purchase of land, 50 acres		$93,500.00			
1891, October 16. Account district attorney, fees, expenses.:....................		6,308.32			
			$99,808.32		
Site adjoining Fort Wadsworth:					
1891, June 29. For purchase of Martin tract, 6¼ acres (to be withdrawn)............		44,000.00			
1891, September 28. For purchase of Hegewisch tract, 14 acres		110,000.00			
1892, May 31. Account district attorney, Martin tract....		339.69			
1892, June 8. Account district attorney, Hegewisch tract.		1,086.20			
			155,425.89		
Site for mortar battery, Point Comfort, N. J.:					
1891, May 27. For services of real-estate expert.........·		155.52			
1891, September 9. For purchase of land, 25.3 acres...		5,060.00			
1892, June 8. For purchase of land.....................		90.00			
			5,305.52		
				$564,992.00	
Hampton Roads, Va.:					
Site for mortar battery, Willoughby Point:					
1891, October 30. For purchase of land, 47 acres, and two rights of way........		23,500.00			
1891, October 30. Account district attorney, fees, expenses, etc.................		515.10			
1891, December 26. Traveling expenses, etc., of clerk....		8.50			
1892, March 30. Clerk of court..	$238.75				
District attorney, expenses.	4.50				
		243.25			
				24,266.85	
Washington, D. C.:					
Site for gun batteries, Sheridan Point:					
1891, February 26. For purchase of land, 291 acres (to be withdrawn)............				19,000.00	
San Francisco Harbor:					
1890, December 13. For services of real-estate expert, etc.........			1,000.00		
Site at Laguna, Merced, for mortar battery:					
1891, June 30. For survey of land......................			49.72		
				1,049.72	
					$888,045.79
					111,954.21

REPAYMENTS TO THE APPROPRIATIONS.

1891, December 30. From Plumb Island, N. Y., allotment	$259.06	
1892, April 12. From Sands Point, N. Y., allotment	4,750.00	
1892, June 28. From Fort Hamilton, N. Y., allotment	684.14	
		$5,693.20
1892, June 30. Amount available		117,647.41

PROTECTION OF THE SITE OF FORT NIAGARA, NEW YORK.

Officer in charge, Capt. Dan C. Kingman, Corps of Engineers; Division Engineer, Col. Henry L. Abbot, Corps of Engineers.

Protection of site.—Operations have been in progress for the protection of the site of Fort Niagara under allotments made from the appropriations for "sea walls and embankments" and preservation and repair of fortifications. The project provides for the repair of the sea wall along the lake front, the construction of dikes of fascines, iron pickets, and stone along the river and a portion of the lake front, and the filling in behind these dikes along the river front to a height of 6 feet above low water, leaving a flat slope down to the water. Above this slope is a level place wide enough for a roadway, then a steeper slope up to the general level of the site, the lower slope to be protected by a growth of willows and the upper one by sod.

The total amount expended under this project to June 30, 1892, is $29,449.38, which has resulted in the repair of the sea wall, the construction of 1,711 linear feet of dike work, 941 feet of which is along the river, the construction of a concrete breakwater in front of the northwest angle to protect the wall, and in grading the bank along the river front according to the project, for a distance of 941 feet. The grading was completed late in the season, and, as it was impossible to induce a growth of willows on this slope that would be any possible protection to it during the winter and spring freshets, it was covered with a rough pavement of stone.

July 1, 1891, balance unexpended	$11,688.95
June 30, 1892, amount expended during fiscal year	11,138.33
July 1, 1892, balance unexpended	550.62
July 1, 1892, outstanding liabilities	30.00
July 1, 1892, balance available	520.62
Amount (estimated) required for completion of existing project	26,105.30
Amount that can be profitably expended in fiscal year ending June 30, 1894	3,000.00

(See Appendix No. 1.)

SEA WALL AND EMBANKMENT AT DAVIDS ISLAND, NEW YORK HARBOR.

Officer in charge, Col. D. C. Houston, Corps of Engineers.

Davids Island, 21 miles distant by water from the Battery, New York city, is one of the principal recruiting stations of the Army.

On the east side of the island was a bay into which garbage and refuse matter frequently drifted, becoming a source of annoyance and possible disease to the troops stationed there; separated from the bay by a low sand beach was a fresh-water pond, formerly used as a water supply during drought, and still used as an ice pond.

To protect the pond from salt water, as well as for sanitary reasons, the construction of a sea wall in front of this beach was recommended in 1883 and 1884. In 1886 $47,000 was estimated as the cost of a masonry wall about 980 feet long, with embankment behind, the wall to be placed near low-water line, and to rise 12 feet above mean low-water level.

Under the appropriation of September 22, 1888, $47,000 was allotted for this sea wall and embankment. Recent stringent regulations prevent the deposit of garbage in this vicinity; therefore a riprap wall with dimension-stone capping was substituted for the masonry wall originally designed, the cost being less and the wall equally effective.

The sea wall was completed in April, 1890.

The wall and embankment are in good condition; slight repair to the embankment is needed where heavy storms have washed away part of the earth.

A survey of the shores of the island, made in June, 1891, to prepare estimates of cost of other needed sea walls upon this island, shows that protection is needed at the west shore, north of the coal dock; a suitable sea wall, with embankment, at this place is estimated to cost $30,000.

Estimates for other sea walls were also presented, but they are not deemed of as pressing importance as this one.

July 1, 1891, balance unexpended	$11,597.86
Amount transferred to allotment for sea wall, Governors Island	6,597.86
July 1, 1892, balance unexpended	5,000.00
Amount (estimated) required for completion of existing project	55,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	30,000.00

(See Appendix 2 A.)

SEA WALLS AT GOVERNORS ISLAND, NEW YORK HARBOR.

Officer in charge, Col. D. C. Houston, Corps of Engineers.

The project adopted in 1865 provided for inclosing the entire island by a sea wall. Under an allotment made in 1865 and other subsequent allotments and appropriations, walls were built on the south, southeast, east, and northwest sides of the island, and under an appropriation of $50,000, made by act of Congress approved August 18, 1890, at the beginning of the fiscal year work had been commenced on a contract for construction of sea wall on the west side of the island.

During the past fiscal year this contract was completed; the wall is 1,499.14 feet long, resting on a concrete foundation (containing 659.24 cubic yards of concrete); 39,544 cubic yards of filling were placed in the embankment behind the wall and 1,856 cubic yards were used to complete the embankment behind the north wall.

With the balance of the available funds a wall about 212 feet long is to be built under a contract recently entered into, extending north from the wall on the east side of the island to and under the quartermaster's wharf.

The existing walls are in good condition, but for preservation they should be repointed in places and parts of the foundation should be protected with riprap.

To complete the wall around the entire island, after the existing contract is finished, there will remain about 185 feet distance, to the shore end of the stone wharf.

The estimated cost of building a wall over this distance is $8,000, and of repointing and riprapping the other walls where necessary, $5,717; total, $13,717.

July 1, 1891, balance unexpended	$53,740.98	
Amount transferred from allotment for sea wall, Davids Island	6,597.86	
		$60,338.84
June 30, 1892, amount expended during fiscal year		46,484.70
July 1, 1892, balance unexpended		13,854.14
July 1, 1892, outstanding liabilities	$180.00	
July 1, 1892, amount covered by uncompleted contracts	4,956.56	
		5,136.56
July 1, 1892, balance available		8,717.58
Amount (estimated) required for completion of existing project		5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		5,000.00

(See Appendix 2 B.)

BEACH PROTECTION, WATER SUPPLY, AND SEWERAGE SYSTEM AT FORT MONROE, VIRGINIA.

Officers of the Corps of Engineers in charge: Lieut. Col. Peter C. Hains, to November 31, 1891; Maj. L. Cooper Overman, from November 23 to December 7, 1891; Capt. Thomas Turtle, from December 7, 1891, to January 25, 1892; and Maj. Charles E. L. B. Davis, since January 25, 1892, with Lieut. George A. Zinn, Corps of Engineers, under their immediate orders; Division Engineer, Col. William P. Craighill, Corps of Engineers.

Beach protection.—The erosion of the beach on the side of the bay and to the northeastward of the fort had progressed so as to endanger the integrity of the sand-spit connecting the fort with the mainland. The approved project consisted of jetties or groins built at suitable intervals along the beach, at an estimated cost of $37,000. Four jetties have been built, of an aggregate length of 927 feet. There has been some fill on the east side of all the jetties, and between them some scour.

July 1, 1891, balance unexpended	$23,985.60
June 30, 1892, amount expended during the fiscal year	23,656.07
July 1, 1892, balance unexpended	329.53
July 1, 1892, outstanding liabilities	89.00
July 1, 1892, balance available	240.53

(See Appendix 3 A.)

Water supply.—The supply of water is dependent upon rainwater stored in cisterns and water of inferior quality brought across Mill Creek in iron pipes. The importance of an adequate supply of wholesome water within the limits of the fortification can hardly be overestimated. Six thousand dollars was appropriated by the act of February 24, 1891, but this amount was not deemed sufficient to sink a well to the depth which it is already shown must be exceeded to secure a supply of good water. A brief account of previous attemps at sinking wells at this post is given in the report of the local officer, who recommends that $4,000 additional appropriation be made.

July 1, 1891, balance unexpended	$6,000.00
July 1, 1892, balance unexpended	6,000.00

(See Appendix 3 B).

Sewerage system.—Twenty-five thousand dollars was appropriated by the act of March 2, 1889, for a *complete* system of sewerage inside and outside of the fort. Bids received for this work showed that the appropriation was insufficient for the purpose. October 29, 1891, the Secretary of War decided that two separate systems must be constructed, one by the United States and the other by the hôtel proprietors and others enjoying the privilege of residing on the reservation. Estimates in accordance with this decision of the Secretary of War were submitted March 12, 1892, amounting to $45,000, and it was recommended that an appropriation of that sum be made for the sewerage system, in lieu of the amount appropriated by the act of March 2, 1889. The numerous reports of the local officer in charge and of the commanding officers and post surgeons show the great and urgent need of this improvement.

July 1, 1891, balance unexpended	$24,902.10
July 1, 1892, balance unexpended	24,902.10

(See Appendix 3 C.)

REPAIR AND PRESERVATION OF FORT MARION, FLORIDA.

Officers in charge, Capt. W. M. Black, Corps of Engineers, to November 20, 1891, and Maj. John C. Mallery, Corps of Engineers, since that date, with Lieut. David DuB. Gaillard, Corps of Engineers, under the immediate orders of the former until November 6, 1891; Division Engineer, Col. William P. Craighill, Corps of Engineers.

The work of restoration of Fort Marion and the improvement of its grounds were begun with an appropriation of $5,000, made in the act approved July 5, 1884. A further appropriation of $15,000 for the restoration of this fort was made in the act approved August 18, 1890. Work under this last appropriation was begun October 20, 1890, and was continued to the close of the fiscal year ending June 30, 1891, as set forth in detail in the Annual Report of the Chief of Engineers for that year.

During the past fiscal year the entire terreplein was coated with a mixture of paraffin and petroleum; drawings for the restoration of the chapel door were made; a covered drain laid for a distance of 260 feet; 60 feet of pavement that had settled was brought up to its proper level, and a number of trees and plants were put out.

Additional and final work of restoration and improvement of fort and grounds remains, as set forth in the report of the officer in charge of the work, which it is estimated will cost $6,500.

July 1, 1891, balance unexpended	$1,218.00
June 30, 1892, amount expended during fiscal year	1,171.47
July 1, 1892, balance unexpended	46.53
July 1, 1892, outstanding liabilities	28.45
July 1, 1892, balance available	18.08

(See Appendix No. 4.)

ESTIMATES OF APPROPRIATIONS REQUIRED FOR 1893-'94.

For construction of gun and mortar batteries	$1,782,000
For purchase of land for fortifications	500,000
For protection, preservation, and repair of fortifications	80,000
For preparation of plans for fortifications	5,000
For protection of site of Fort Niagara, New York	3,000

For sea walls and embankments	$35,000
For purchase of submarine mines and necessary appliances to operate them for closing the channels leading to our principal seaports	100,000
For needful casemates, cable galleries, etc., from which to operate submarine mines	150,000
For continuing torpedo experiments	10,000
	2,665,000

THE BOARD OF ENGINEERS.

The Board, as at present constituted, consists of the following officers of the Corps of Engineers: Col. Henry L. Abbot, Col. C. B. Comstock, Col. D. C. Houston, and Lieut. Col. G. L. Gillespie.

Col. G. H. Mendell, Corps of Engineers, is also a member of the Board when it is acting upon matters pertaining to the defensive works on the Pacific coast.

The Board has considered the various subjects referred to it during the past year by the Chief of Engineers, and the following is a brief summary of the reports rendered thereon:

1891, July 9. On project of Lieut. Col. P. C. Hains, Corps of Engineers, for gun emplacement at Fort Washington, Md.

September 1. On project of Mr. C. Farrington for a turret for shore purposes.

September 29. On an application for permission to level off an unfinished battery at Governors Island, N. Y.

October 14. On project of Maj. T. H. Handbury, Corps of Engineers, for obtaining a navigable channel in the lower Willamette and Columbia rivers.

October 16. On project of Maj. C. W. Raymond, Corps of Engineers, for a mining casemate and cable gallery at fort opposite Fort Delaware.

October 26. On plan of Mr. Patrick McCann for a land fortress.

October 26. On plan of Mr. Owen Foley for a chevaux-de-frise.

November 30. On pamphlet of Lieut. Honeycutt on the "Relative average effect of parallel and independent fire."

December 9. On plan of Mr. John Dougherty for a revolving fort.

December 9. On project of Lieut. Col. S. M. Mansfield, Corps of Engineers, for gun emplacement at Fort Warren, Mass.

December 14. On modified plans of the North River Bridge Company for a bridge across the Hudson River at New York City.

December 16. On Senate 455, Fifty-second Congress, first session, "To authorize the New York and New Jersey Bridge Company to construct and maintain a bridge across the Hudson River between New York City and the State of New Jersey."

December 21. On Senate 846, Fifty-second Congress, first session, "To authorize and regulate the construction of bridges across the Hudson and East rivers, at the city of New York and prescribe the dimensions of the same."

December 26. On purchase from the Highland Beach Association of land adjacent to Sandy Hook, N. J.

December 28. On defenses of Long Island Sound—eastern entrance.

1892, January 12. On purchase of armored cable.

January 15. On House of Representatives 289, Fifty-second Congress, first session, "To incorporate the New York Bridge Company, for the purpose of constructing, maintaining, and operating a bridge over East River, between the cities of New York and Brooklyn, in the State of New York."

January 26. On plan of Mr. John Hegeman for a folding boat for ponton bridges.

January 26. On project of Lieut. Col. G. L. Gillespie, Corps of Engineers, for the defense of the gorge of a gun-lift battery at Sandy Hook.

January 29. On suggestions of Mr. Burwell Blair for locating hostile vessels entering a harbor.

January 30. On memorial of Port Townsend Board of Trade for the defense of Puget Sound.

February 1. On project of Maj. W. A. Jones, Corps of Engineers, for the improvement of the Red River of the North and Big Stone Lake.

February 8. On plan of Mr. John Nader for a movable spar torpedo for harbor defense.

February 8. On plan of Mr. H. G. Lane for a steel fort.

February 8. On plan of Mr. Edwin Bell for formation of artificial bars to exclude hostile vessels.

February 12. On plan of Mr. Charles Boeckh for deepening and navigating channels.

March 3. On device of Mr. C. K. Corliss for directing the movements of torpedoes.

March 3. On Senate 2295, Fifty-second Congress, first session, "To provide for the appointment of an Ohio River Commission for the improvement of said river from Pittsburg to Cairo."

March 10. On specifications for submarine-mining cable proposed by Lieut. Col. W. R. King, Corps of Engineers. The report of the Board was accompanied by a memorandum on the subject by Col. H. L. Abbot, Corps of Engineers, dated March 9, 1892.

March 28. On electrical defense scheme of Gen. G. W. Serrell.

March 28. On Senate 2626, Fifty-second Congress, first session, "To authorize the New York and New Jersey Bridge Companies to construct and maintain a bridge across the Hudson River between New York City and the State of New Jersey."

March 28. On plan of Mr. Charles H. Buckalew for submarine tunnels.

April 2. On request of the Mount Morris, N. Y., bank directors for authority to partially fill in the Harlem River; and on their application that War Department orders relative to the height of the New York Central Railroad Company's bridge across the Harlem River be rescinded.

April 6. On House of Representatives 7819, Fifty-second Congress, first session, "to authorize the construction of bridges over the North or Hudson River between the States of New York and New Jersey."

April 7. On plan of Mr. C. F. Shedd for wire foot nets for obstructing an enemy's men and horses.

April 28. On plan of Mr. George Cowing for the auxiliary defense of harbors and coasts.

April 28. On House of Representatives 8312, Fifty-second Congress, first session, "to authorize the New York and New Jersey Bridge Companies to construct and maintain a bridge across the Hudson River between New York city and the State of New Jersey."

May 26. On the defense of the eastern entrance to New York Harbor at and near Throgs Neck.

May 26. On plan of Maj. M. B. Adams, Corps of Engineers, for strengthening the superstructure of the Buffalo Breakwater.

In the performance of the duties of the Board, the following personal examinations were made:

Under instructions of the Chief of Engineers, dated July 28, 1891, the Board, in connection with its report on the defenses of the eastern entrance of Long Island Sound, made an inspection of the locality covered by the report on August 28, 1891.

Under instructions of the Chief of Engineers, dated March 18, 1892, the Board made an inspection of the defenses of Savannah, Ga., on April 12 and 13, and of Charleston, S. C., on April 14, 15, and 16, 1892.

Under instructions of the Chief of Engineers, dated June 6, 1892, the Board, on June 13, 1892, made an inspection of the barges containing powder and other explosives, anchored near Ellis and Bedloes islands, New York Harbor. This matter was investigated at the request of the Treasury Department in view of complaints that the lives and property of people on the New Jersey shore were menaced by these barges.

In addition to their duties with The Board of Engineers, the individual members of the Board have been otherwise engaged as follows:

1. Col. Henry L. Abbot, the president of the Board, has continued in charge of certain experiments with torpedoes; as a member of the Board of Ordnance and Fortification; as president of the Board to fix the harbor lines for the harbor of New York and its adjacent waters; and as division engineer of the Northeast division. He has also served as president of Boards for examination of officers of the Corps of Engineers with a view to promotion, and as president of the Board to fix the harbor lines of the port of Boston. He has recently been detailed on a Board to consider and report upon the subject of harbor lines for Oswego, N. Y.

2. Col. C. B. Comstock has served as division engineer of the Southwest division; as member of the Board of Visitors to the U. S. Engineer School; as president of the Mississippi River Commission; as member of the Board to fix the harbor lines of New York Harbor and its adjacent waters; as member of the Board to fix the harbor lines of Philadelphia; as member of a Board for examination of officers of the Corps of Engineers with a view to their promotion; and is under orders to represent the War Department at the Fifth Congress of Internal Navigation at Paris, France.

3. Col. D. C. Houston has been the disbursing officer of The Board of Engineers. He has conducted the various works of river and harbor improvement and of fortifications under his charge, and he has served as a member of the Board of Visitors to the U. S. Engineer School; as a member of the Board to fix the harbor lines for the harbor of New York and its adjacent waters; as a member of Boards to establish harbor lines in the harbors of Stamford and Bridgeport, Conn.; as member of Board for examination of officers of the Corps of Engineers with a view to promotion; and is a member of the Board to consider harbor lines for Norwalk, Conn.

4. Lieut. Col. G. L. Gillespie, in addition to conducting the various works of river and harbor improvement and of harbor defense with which he was charged during the year, has continued to serve as a member of the Board of Visitors to the U. S. Engineer School; on harbor-line Boards for the harbors of New York, Stamford, and Bridgeport; on the Board on the subject of obstructions to navigation in the Hudson River; and on the Board to consider a deep-water harbor on the Pacific Coast between Points Duma and Capistrano. He also served on the harbor-line Board for the port of Boston, and is a member of the Board to consider harbor lines for Norwalk, Conn.

POST OF WILLETS POINT, NEW YORK—UNITED STATES ENGINEER SCHOOL—BATTALION OF ENGINEERS—ENGINEER DEPOT.

Officer in command, Lieut. Col. W. R. King, Corps of Engineers.

POST OF WILLETS POINT, NEW YORK.

At the close of the fiscal year the garrison consisted of 24 commissioned officers and 353 enlisted men, including officers and noncommissioned officers of the general staff, student officers, and enlisted men of the Hospital Corps. This is a loss of 3 officers and a gain of 20 men in strength over last year's report.

Repairs and improvements have been made during the year to roads, sidewalks, and buildings, and two new brick barracks and a guard-house have been begun by the Quartermaster's Department. A brick house for the fire engines and appliances has been completed and extensive repairs to the quartermaster's wharf have been commenced. The new guard-house is nearly ready for use.

One more barrack, a building for the post mess for enlisted men, and a storehouse near the wharf for quartermaster's and commissary stores, as heretofore reported, are very much needed for the comfort of the garrison as well as for the proper handling and storage of public property.

The drill, discipline, instruction, and sanitary condition of the garrison have been satisfactory and compare favorably with the attainments of former years, as shown by the comparative statement in appendix.

UNITED STATES ENGINEER SCHOOL.

During the year 6 engineer officers, 2 cavalry, 1 artillery, and 5 infantry officers completed the course, and 7 infantry officers who have completed the laboratory duty are still engaged in the practice work of planting and operating torpedoes, which it is expected will be completed October 1, 1892.

All have manifested intelligence and interest in the work and are entitled to certificates of proficiency in one or more of the branches they have been studying and practicing.

BATTALION OF ENGINEERS.

The legal strength of the Battalion of Engineers is five companies, of 150 men each, with a sergeant-major, and quartermaster sergeant, and is officered by details from the commissioned officers of the corps.

The present strength is 18 officers and 437 enlisted men.

The authorized strength of companies A, B, and C, which are stationed at Willets Point, is 133 men each, and of Company E, stationed at West Point, 100 men.

The total losses from all causes during the year have been 149, and the total gain 169, making a net gain of 20 men.

The battalion has been employed during the year at engineer, pontoon and torpedo drills, infantry drill, rifle practice, photography; and company E, at West Point, has assisted in the instruction of cadets in military engineering and pontoon drill.

ENGINEER DEPOT.

The fireproof storehouse referred to in last report is nearly completed, and the work of arranging the pontoon, siege, and torpedo materials and appliances in it is well under way. This building will furnish all the storage room needed for many years to come.

The small tug for planting torpedoes has been placed under contract and is to be completed by the end of September.

A quantity of lumber and other materials have been procured for the purpose of replacing the old and worn-out pontoon bridge equipage.

The buildings and machinery for trials of the Sims-Edison Torpedo have been provided and are now in use for the purpose intended.

A concrete tank for insulated torpedo cable has been built and is now in use for storing cable.

The depot property, such as torpedo, pontoon materials, and instruments, have been cared for, and the usual purchases, receipts, issues, and repairs have been made.

Experiments have been continued, including the trials of the Sims-Edison Torpedo, tests of building materials, fuses, circuit closers, mooring rope, shackles, etc., details of which will be found in appendixes, or have been made the subject of special reports.

STATEMENT OF FUNDS.

Congress has at various times appropriated as follows:

1. For engineer depot at Willets Point, N. Y., for the fiscal year ending June 30, 1892, the amount of	$11,000.00
Expended and pledged	10,996.75
For engineer depot at Willets Point, N. Y., (no limit) for fireproof storehouse, the amount of	16,000.00
Expended and pledged	12,468.34
Outstanding liabilities	558.15
July 1, 1892, balance available	2,973.51
2. Torpedoes for harbor defense, act September 22, 1888:	
July 1, 1891, balance unexpended	17,316.75
July 1, 1892, balance unexpended and available	5,088.33
3. Torpedoes for harbor defense, act March 2, 1889:	
July 1, 1891, balance unexpended	121,713.93
June 30, 1892, assigned during fiscal year	5,000.00
July 1, 1892, balance unexpended and available	21,315.54
4. Torpedoes for harbor defense, act August 18, 1890:	
July 1, 1891, balance unexpended	46,748.54
July 1, 1892, balance unexpended and available	24,598.85
5. Torpedoes for harbor defense, act February 24, 1891:	
July 1, 1891, balance unexpended	16,742.08
July 1, 1892, balance unexpended and available	83.70
6. Torpedoes for harbor defense, acts March 2, 1889, and August 18, 1890:	
Reallotted during fiscal year for purchase of American Submarine Cable, total amount	74,961.12
July 1, 1892, balance unexpended and available	74,961.12
7. For engineer depot at Willets Point, N. Y., for the fiscal year ending June 30, 1893	15,000.00

There will be required for the fiscal year ending June 30, 1894, for the engineer depot at Willets Point, N. Y., viz:

1. For incidental expenses of depot	$5,000.00
2. For purchase of materials for instruction of battalion	3,500.00
3. For purchase and repair of instruments	3,000.00
4. For purchase and binding of professional works for library	500.00
Total	12,000.00

(See Appendix No. 5.)

RIVER AND HARBOR IMPROVEMENTS.

The funds with which the works for the improvement of rivers and harbors were prosecuted during the last fiscal year were derived from the appropriations by the river and harbor act approved September 19, 1890, appropriations in the sundry civil act approved March 3, 1891, for certain works on account of which contracts were to be made for completion as provided in the act of September 19, 1890, and such balances of former appropriations as were available.

A brief statement derived from the reports of the officers in charge of the several works hereinafter given sets forth the condition of each improvement, the extent of work performed during the last fiscal year, the amount expended, and estimate of amount required for its completion.

Section 2 of the river and harbor act approved March 2, 1867, requires that the Secretary of War shall annually submit to Congress a full estimate for the entire and permanent completion of each river and harbor work, and of the amount that can be profitably expended on each uncompleted work in the next fiscal year.

It is believed that sufficient funds are provided by the river and harbor act approved July 13, 1892, to carry the works through the fiscal year of 1894, except in the cases of works on account of which contracts are to be made for their completion as provided in the river and harbor acts of 1890 and 1892, and consequently estimates for this last class of works only are submitted. Each report, however, sets forth the amount necessary to complete the work in question, and provides a basis upon which items of appropriation can, if necessary, be formulated.

Reports are appended of the work accomplished in the removal of wrecks obstructing or endangering navigation, as provided for in section 4 of the river and harbor act approved June 14, 1880, and enlarged by provision in the river and harbor act of August 2, 1882.

Under the authority given to the Secretary of War in section 12 of the river and harbor act approved September 19, 1890, harbor lines have been established at the following localities:

Five Mile River Harbor, Connecticut; New York Harbor and adjacent waters; Anacostia River (Eastern Branch of the Potomac, Washington, D. C.); South Branch of Elizabeth River, at navy-yard, Norfolk, Virginia; San Pedro, Wilmington Harbor, California; San Diego Harbor and adjacent waters, California; Willamette River at Portland, Oregon; Vancouver Harbor (Columbia River), Olympia Harbor, and Bellingham Bay (at New Whatcom and Fair Haven, Washington).

Examinations were made whenever required by the committees of Congress of proposed bills authorizing the construction of bridges upon which the views of the War Department were desired. Of the bills so examined 34 originated in the Senate, and 56 in the House of Representatives.

During the fiscal year examinations were made of such plans and locations as were submitted by parties interested, of bridges proposed to be built over navigable waters subject to the approval of the Secretary of War, as authorized by acts of Congress. A brief statement is given of the action had in such cases.

Under sections 4 and 5 of the river and harbor act approved September 19, 1890, persons, corporations, or associations owning or controlling bridges over navigable water ways of the United States, which are unreasonable obstructions to the free navigation of such waters, after being given a reasonable opportunity to be heard, have been notified to so alter the bridges as to render navigation through or under them reasonably free, easy, and unobstructed. In each case the changes required to be made were specified in the notice, and reasonable time was prescribed in which to make them. A detailed statement of the cases is given further on in this report.

Reports made in compliance with the requirements of section 2 of the river and harbor act of July 5, 1884, and section 4 of that of August 5, 1886, of instances in which piers, breakwaters, or other works built by the United States in aid of commerce or navigation are used, occupied or injured by a corporation or an individual, will be found in Appendix Z Z.

The engineering works in the charge of this office are arranged in five divisions, and officers of the corps assigned as division engineers to overlook the work, as follows:

West of the Rocky Mountains: Pacific Division, Col. George H. Mendell. East of the Rocky Mountains: Northeast Division, Col. Henry L. Abbot; Southeast Division, Col. Wm. P. Craighill; Southwest Division, Col. Cyrus B. Comstock; Northwest Division, Col. Orlando M. Poe.

South Pass of the Mississippi River.—During the fiscal year ending June 30, 1892, the legal channel was maintained at the head of South Pass and through the Pass itself, but during a period of thirty-two days, from May 20 to June 20, both dates inclusive, such channel did not obtain through the jetties at the mouth of the Pass. During this period, however, there was a navigable depth of 28.1 feet.

Rules and regulations for the use of canals.—Section 7 of the river and harbor act approved July 5, 1884, authorized the Secretary of War to prescribe proper rules and regulations for the administration, and use by the public, of the Des Moines Rapids Canal, the St. Marys Falls Canal, and the Louisville and Portland Canal, and provided penalties for willful violations of such rules. Similar legislation was subsequently enacted by acts of August 11, 1888, and September 19, 1890, applying to the South Pass of the Mississippi River and the Des Moines Rapids Dry Dock.

It is desirable that similar authority should be granted to the Secretary of War with respect to all the canals owned and operated by the Government, and that the willful violation of such rules as may be prescribed should be declared a misdemeanor, and penalties therefor be provided. The need of rules to govern the use and navigation of these works, and of adequate provision for their enforcement, applies alike to all the canals. Express legislation in some cases indicates that Congressional action is necessary in all cases for the sufficient and proper enforcement of whatever rules the Secretary of War may promulgate, and difficulty has already arisen from the lack of authority to enforce rules and regulations prescribed for the use of canals not embraced in existing enactments.

The following draft of an act, which will, it is believed, accomplish the objects desired with respect to all United States canals and similar works of navigation, is proposed and recommended for passage by Congress:

AN ACT providing for the establishment and enforcement of rules and regulations for the use and navigation of United States canals and similar works of navigation, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be, and is hereby, authorized to prescribe and publish such rules and regulations for the government, use, and navigation of any or all canals and similar works of navigation that now are or hereafter may be owned, operated, or maintained by the United States as may seem necessary, proper, or expedient for the purpose of regulating the use of such canals or similar works by vessels passing through them, and of preventing any obstruction to the channels through such canals or similar works and any injury to the bed and banks thereof, and to the works constructed for the improvement or in connection with them.

SEC. 2. That any willful violation of any rule or regulation made by the Secretary of War in pursuance of this act shall be deemed a misdemeanor, for which the owner or owners, agent or agents, master or pilot of the vessel offending shall be separately and collectively responsible, and on conviction thereof, in any district court in the United States within whose territorial jurisdiction such offense may have been committed, shall be liable to punishment by a fine not exceeding five hundred dollars or by imprisonment not exceeding six months, at the discretion of the court, for each offense.

SEC. 3. That it shall be the duty of all persons using or navigating such canals or similar works, their channels and approaches, or using any of the piers, breakwaters, docks, wharves, or other improvements belonging to the United States, to observe the regulations prescribed by the Secretary of War as aforesaid; and any person who shall willfully or negligently strand or sink any steam vessel, boat, or craft in such canals or similar works, or in the channels or approaches, or who shall willfully or negligently, or by failure or neglect to observe the regulations prescribed by the Secretary of War for the use thereof, obstruct or impair such canals or similar works, or cause any impediment, injury, filling up, or shoaling therein, or in the approaches thereto, tending to obstruct or impair the navigation thereof, or who shall willfully damage or injure the piers, breakwaters, wharves, docks, or other improvements of such canals or similar works belonging to the United States, or who shall fail to obey or observe any of said prescribed regulations, shall be liable to the penalty prescribed by section two of this act, and shall, in addition thereto, be liable to the United States, or to any person aggrieved by such obstructions, or injuries, or unlawful acts, or omissions, in a civil action for all damages occasioned thereby, or by any of said unlawful acts, to said United States or such aggrieved person.

ATLANTIC COAST AND GULF OF MEXICO.

IMPROVEMENT OF RIVERS AND HARBORS IN MAINE AND NEW HAMPSHIRE.

Officers in charge, Lieut. Col. Jared A. Smith, Corps of Engineers, to December 3, 1891, and Lieut. Col. Peter C. Hains, Corps of Engineers, since that date.

1. *St. Croix River, Maine.*—An examination and survey of the St. Croix River were made under the provisions of the river and harbor act of August 11, 1888, and the reports on same were published in the Annual Report of the Chief of Engineers for 1890 (page 463). The available depth, at mean low water, over the shoals, was found to be from 6.5 to 9.5 feet, and in the upper part of the harbor at Calais but 1.5 feet. The channel was also narrow. In the report on the survey it was proposed to obtain a channel 12 feet deep at mean low water, with a general width of 200 feet, but narrowed to 150 and 100 feet at the upper end. Such an improvement would enable steamboats to reach landings at the upper end of the harbor, and would allow large lumber vessels to fully load at the wharves instead of having to drop down stream about 4 miles to complete their cargoes.

An appropriation of $35,000 was made by act approved September 19, 1890, coupled with the proviso "that the Government of the Dominion of Canada shall expend a like sum in the improvement of said river."

No work has yet been done, pending action by the Dominion Government, and none of the appropriation has been expended.

July 1, 1891, balance unexpended	$35,000.00
July 1, 1892, balance unexpended	35,000.00
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	245,000.00

(See Appendix A 1.)

2. *Lubec Channel, Maine.*—This channel lies between the eastern extremity of the State of Maine and Campobello Island, Dominion of Canada.

Originally the channel was but 5 feet in depth at mean low water, and but 2 feet at low water of spring tides.

The project, adopted in 1879, and subsequently modified, was for a channel 275 feet wide, 300 feet wide in the bends, and 12 feet deep at mean low water.

The expenditures to June 30, 1891, amounted to $168,929.42.

The expenditures during the past year were $25.

At the close of the fiscal year 1891 the project had been practically completed, and no work has been done since.

Under the provisions of the river and harbor act of September 19, 1890, an examination of Lubec Channel was made, and the report was published in the Annual Report of the Chief of Engineers for 1891 (page 616).

July 1, 1891, balance unexpended	$70.58
June 30, 1892, amount expended during fiscal year	25.00
July 1, 1892, balance unexpended	45.58

(See Appendix A 2.)

3. *Moosabec Bar, Maine.*—Before the improvement was commenced the entrance at the eastern end of Moosabec Reach was difficult, the channel being crooked, with ledges on either hand. The direct entrance was obstructed by a bar on which the depth was only about 6 feet at mean low water.

The project, adopted in 1881, provided for a channel 14 feet deep at mean low water, and not less than 200 feet wide, through the bar at the eastern entrance to the reach. In 1888 the project was extended to provide for widening the 14-foot channel to 300 feet, for removal of ledges obstructing the channel, and for the construction of a small breakwater to divert cross currents.

The expenditures to June 30, 1891, were $53,888.29. At the latter date the 300-foot channel had been completed to the full projected width and depth, the construction of the breakwater had been commenced, and a small quantity of ledge had been removed.

The expenditures during the past year amount to $6,530.48, which was applied to the completion of the small breakwater included in the project. The work remaining to be done consists of the removal of ledges obstructing the channel at its west end.

The benefits derived from the improvement are not local, the thoroughfare being extensively used by coastwise vessels, both as a harbor of refuge and as a sheltered route.

July 1, 1891, balance unexpended	$16,111.71
June 30, 1892, amount expended during fiscal year	6,530.48
July 1, 1892, balance unexpended	9,581.23
Amount appropriated by act approved July 13, 1892	15,000.00
Amount available for fiscal year ending June 30, 1893	24,581.23
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	65,000.00

(See Appendix A 3.)

4. *Pleasant River, Maine.*—Originally the channel above Addison Point was obstructed by bowlders, while below navigation was rendered

dangerous by two rocks and a shoal of ledge and gravel in mid-river. The act of September 19, 1890, appropriated $3,500 for completing the improvement.

The project was to mark the rocks by a beacon and the shoal by a spindle, the remainder of the appropriation to be expended in removing bowlders from the channel above Addison Point, the work to be done by hired labor and purchase of materials in open market.

The work was commenced in June, 1891, and completed during the following August. A stone beacon was built on "Channel Rocks" and an iron spindle was established on the shoal known as "Coffins Rocks." Seventy large bowlders, weighing in the aggregate about 55½ tons, besides about 100 smaller ones, were removed from the river above Addison Point.

July 1, 1891, balance unexpended	$3,500.00
June 30, 1892, amount expended during fiscal year	3,500.00

(See Appendix A 4.)

5. *Narraguagus River, Maine.*—The obstruction to navigation consisted in a bar at the mouth of the river, over which there was a navigable depth of less than 6 feet at mean low water, and less than 4 feet at extreme low water.

The project for improvement is to dredge a channel not less than 200 feet wide, having 11 feet depth at mean low water, from the deep water of the bay to Long Point, and a depth of 9 feet from thence to the anchorage.

The expenditures to June 30, 1891, amounted to $22,341.57.

At the latter date the following work had been accomplished: At the lower steamboat wharf, and at the new steamboat wharf, about 1,800 feet further down stream, the channel had been dredged to a width of about 300 feet. Between these points the channel was about 100 feet wide. From the new steamboat wharf to the deep water of the bay the dredged channel had widths of 90 and 55 feet. All dredging was to the full depth of 11 feet at mean low water.

The expenditures during the fiscal year ending June 30, 1892, amounted to $5,121.85, chiefly for liabilities incurred during the previous fiscal year. The contract for dredging which was in progress at the date of the last annual report, was completed July 11, 1891, and no work has been done since, so that practically no work has been in progress during the year just ended. By the dredging done during July, 1891, a least channel width of 90 feet was obtained from the new steamboat wharf to the deep water of the bay.

July 1, 1891, balance unexpended	$5,158 43
June 30, 1892, amount expended during fiscal year	5,121.85
July 1, 1892, balance unexpended	36.58
Amount appropriated by act approved July 13, 1892	7,500.00
Amount available for fiscal year ending June 30, 1893	7,536.58
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	15,000.00

(See Appendix A 5.)

6. *Breakwater from Mount Desert to Porcupine Island, Maine.*—The anchorage in front of the town of Bar Harbor, as well as the wharves at which steamers land, is exposed to storms and seas from southerly directions, at times rendering the anchorage insecure, and the landing of passengers and freight at the wharves difficult.

The original project was to construct a riprap breakwater in a direct line from Porcupine Island to Dry Ledge, and thence to within a short distance of Mount Desert Island. The direction of that portion west of Dry Ledge was afterward slightly changed, so that the westerly end of the breakwater will be somewhat further to the southward.

The expenditures up to the close of the fiscal year ending June 30, 1891, amounted to $19,144.53. Up to the latter date operations had been confined to that part of the work between Porcupine Island and Dry Ledge, and 17,520 tons of stone had been placed in position, or rather more than one-fourth of the entire quantity (66,000 tons) estimated for that portion of the breakwater. The work had not reached a stage to be of much benefit to the harbor.

The expenditures during the last fiscal year were $15,060.84, making the total expenditures under the project $34,205.37. At the date of the last annual report work was in progress, under contract. About the middle of November, 1891, after 19,080 tons of stone had been delivered, the contractor stopped work. Subsequently, in March, 1892, the contract was annulled, on the ground that it had been assigned.

The entire quantity of stone placed in the work is 30,473 tons, which was all deposited in that part between Porcupine Island and Dry Ledge. During June, 1892, new contracts were let for continuing the work, operations to be commenced by July 1, 1892.

July 1, 1891, balance unexpended		$80,855.47
June 30, 1892, amount expended during fiscal year		15,060.84
July 1, 1892, balance unexpended		65,794.63
July 1, 1892, outstanding liabilities	$50.00	
July 1, 1892, amount covered by uncompleted contracts	64,585.00	
		64,635.00
July 1, 1892, balance available		1,159.63
Amount appropriated by act approved July 13, 1892		50,000.00
Amount available for fiscal year ending June 30, 1893		51,159.63
Amount (estimated) required for completion of existing project		656,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix A 6.)

7. *Bagaduce River, Maine*.—When the project for improving this locality was adopted the channel near South Penobscot was crooked and obstructed by ledges of rock, and the least depth at low tide did not exceed 2 feet.

The approved project is to obtain, by dredging and rock excavation, a channel 100 feet wide, and 6 feet deep at low tide, from Bridges Point to Bowden's Wharf, South Penobscot, a distance of about 4,000 feet, the cost being estimated at $45,000. It was also intended to remove a small quantity of rock obstructing the southern channel at Johnsons Narrows, at an estimated cost of $1,875.

The expenditures to the close of the fiscal year ending June 30, 1891, amounted to $100, which were for preparation of plans, etc. No work had been done. The first appropriation, $3,000, was too small to be judiciously expended. Enough rock excavation to be of any practical benefit could not be accomplished with that amount, and the situation was such that without the removal of rock no practical benefits could be acquired by dredging.

There were no expenditures during the fiscal year ending June 30, 1892, and no work was done.

July 1, 1891, balance unexpended	$6,900.00
July 1, 1892, balance unexpended	6,900.00
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	11,900.00
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	34,875.00

(See Appendix A 7.)

8. *Penobscot River, Maine.*—The improvement of the Penobscot River was first undertaken in 1870, the project being for a channel not less than 150 feet wide, 12 feet deep at low tide, as far up as Bangor. At that time the channel was shoal and dangerous. At Bangor the depth did not exceed about 6 feet at lowest stages, and navigation was obstructed by numerous rocks and ledges. The work was continued until 1880, and included also the removal of obstructions in the harbor at Bangor, and at Bucksport, the expenditures aggregating $198,000. No further work was done until 1884, when a project was adopted for widening the channel at Bangor, and for certain improvements in the river below, near Crosbys Narrows, at an estimated cost of $75,000. While this work was in progress a survey was made, under the river and harbor act of 1886, from Bangor to Bucksport Narrows, and a project was submitted for securing a 22-foot depth between Bucksport and Winterport, at an estimated cost of $365,000, making the combined cost of the two projects $440,000. The act of September 19, 1890, appropriated $25,000, and provided for dredging near Stern's Mill.

Another survey was ordered by the act of September 19, 1890, which has been made, and the report published as House Ex. Doc. No. 37, Fifty-second Congress, first session. (See also Appendix A 25.)

The appropriations up to the close of the fiscal year ending June 30, 1891, aggregated $308,300, and the expenditures under the various projects to the same date amounted to $278,746.02. The results were the widening and deepening of the channel at Bangor from a depth of 6 feet at extreme low tide, to 14 feet, the removal of rocks, ledges, and other obstructions, the removal of a shoal near Bucksport, and a general increase in depth and width of channels from the mouth up to Bangor.

The expenditures during the fiscal year ending June 30, 1892, amounted to $5,586.85. The contract for dredging at the shoal above Crosbys Narrows, which was in progress at the close of the fiscal year 1891, was completed in November last, the total quantity of material dredged under the contract being 60,004 cubic yards.

Under the appropriation of September 19, 1890, a contract was made, under date of November 14, 1891, for dredging near Stern's Mill. Work was commenced about the middle of May, 1892, and at the close of the fiscal year about 12,000 cubic yards of material had been excavated.

July 1, 1891, balance unexpended		$29,553.98
June 30, 1892, amount expended during fiscal year		5,586.85
July 1, 1892, balance unexpended		23,967.13
July 1, 1892, outstanding liabilities	$415.00	
July 1, 1892, amount covered by uncompleted contracts	22,500.00	
		22,915.00
July 1, 1892, balance available		1,052.13
Amount appropriated by act approved July 13, 1892		40,000.00
Amount available for fiscal year ending June 30, 1893		41,052.13

Amount (estimated) required for completion of existing project	$290,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 8.)

9. Belfast Harbor, Maine.—Originally the harbor was not deep enough to accommodate the commerce. At one place in the harbor the depth was only about 4 feet at mean low tide.

In 1876 a project for dredging was adopted, and the work was completed in 1879 at a cost of $22,000. No more work was done until 1890, when a new project was adopted by which it was proposed to dredge a channel 220 feet wide, and 15 feet deep at mean low tide, from the deep water at the entrance to the upper harbor; to dredge an area on the north side of the harbor to a depth of 8 feet; and to dredge an area on the south side of the channel to a depth of 13 feet.

The total expenditures up to June 30, 1891, were $23,588.95. At the latter date a contract was in progress for dredging the area on the northerly side of the harbor to the 8-foot depth proposed, which was the first work undertaken under the new project. At the close of the year 11,007 cubic yards of material had been dredged.

The expenditures during the last fiscal year were $11,411.05, which exhausted the funds. The contract for dredging the 8-foot area, which was in progress at the date of the last Annual Report, was completed October 1, 1891, the total amount dredged being 69,110 cubic yards, scow measurement. This completed the 8-foot dredging contemplated by the project, and leaves the 13-foot and 15-foot dredging yet to be done.

July, 1, 1891, balance unexpended	$11,411.05
June 30, 1892, amount expended during fiscal year	11,411.05
Amount appropriated by act approved July 13, 1892	10,000.00
Amount (estimated) required for completion of existing project	32,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 9.)

10. Camden Harbor, Maine.—Before the improvement was commenced vessels drawing more than 6 feet could not reach the wharves at low tide.

The improvement projected is to dredge an area at the eastern part of the entrance to a depth of 12 feet at mean low tide; to dredge a channel on each side of the harbor, and the approach to the same, to a depth of 10 feet at mean low tide; to dredge small channels at the upper end of the harbor to a depth of 5 feet at mean low tide; and, after completion of the above items, to dredge the middle ground of the harbor to the same depths as the adjacent channels.

The expenditures up to the close of the fiscal year ending June 30, 1891, on the latest project, amounted to $5,031.17. As a result the western channel had been dredged to a depth of 10 feet at mean low tide throughout its entire length including the approach. The width for a distance of about 1,150 feet from the lower end was 75 feet, and from thence to the upper harbor it was 50 feet.

The expenditures during the last fiscal year were $5,968.83, exhausting the funds. The operations consisted in widening the western channel. The work was done by contract, which was completed September 3, 1891, the quantity dredged being 30,664 cubic yards. By this dredging the approach to the western channel was widened to 125 feet, and the channel itself to 100 feet throughout its entire length.

July 1, 1891, balance unexpended	$5,968.83
June 30, 1892, amount expended during fiscal year	5,968.83
Amount appropriated by act approved July 13, 1892	12,000.00
Amount (estimated) required for completion of existing project	37,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 10.)

11. Rockport Harbor, Maine.—This is a small harbor, though of considerable commercial importance, on the west side of Penobscot Bay.

Before the improvement was commenced the available depth along the wharves in the upper part of the harbor was but 4 feet at mean low tide.

The project adopted in 1888 provided for dredging the shoal area in the upper harbor to a depth of 12 feet at mean low tide, and for removing a small ledge at the eastern side of the area proposed to be dredged to the same depth.

The expenditures up to the close of the fiscal year ending June 30, 1891, amounted to $10,088.81. At the latter date more than two-thirds of the area included in the project had been dredged to the full depth of 12 feet at mean low tide.

The expenditures during the last fiscal year were $4,911.19, exhausting the funds. Work was commenced, under contract, on August 4, 1891, and completed August 18, 1891, by which 15,000 cubic yards of material were dredged and 60 cubic yards of ledge removed. This completed the project.

July 1, 1891, balance unexpended	$4,911.19
June 30, 1892, amount expended during fiscal year	4,911.19

(See Appendix A 11.)

12. Rockland Harbor, Maine.—The location of Rockland Harbor is such that, besides accommodating its own commerce, it affords a convenient refuge for large numbers of coasting vessels. When the project for a breakwater was adopted the harbor was open to easterly storms, the anchorage was unsafe, and the seas often broke over the wharves.

The project as originally adopted in 1881 provided for two breakwaters—one starting from Southwest Ledge in the harbor, and running in a northerly direction toward Jameson Point, a distance of 2,640 feet, the other starting from Jameson Point, and extending southward about 1,900 feet. The estimated cost was $550,000. The top of each breakwater was to be only 5 feet above the level of mean low tide.

In 1887 the project was amended so as to bring the top of the breakwater from Jameson Point to the level of high tide, leaving the other as originally designed. The estimated cost was thus increased to $650,000.

In 1890 the project was again modified. Instead of building the second breakwater from Southwest Ledge in a northerly direction, on which no work had been done, it was decided to prolong the one from Jameson Point in a southerly direction. By doing so a much larger area of the harbor would secure protection. The estimated cost of the new project was $632,500, this being inclusive of the part already constructed.

Up to the close of the fiscal year ending June 30, 1891, there had been expended on the breakwater the sum of $153,058.51, and about 156,500 tons of stone had been placed in position. The above expenditures had resulted in protecting a part of the harbor, giving a secure harbor of refuge for many vessels that trade near this port.

During the fiscal year ending June 30, 1892, there has been expended the sum of $16,326.97. This expenditure has added to a small extent to the area of protected harbor. During the year there has been deposited about 23,500 tons of stone in the breakwater, the price paid being 78½ cents per ton of 2,000 pounds, the work being done by contract by William S. White, of Rockland, Me. Up to the close of the year there had been deposited in the entire breakwater about 180,000 tons of stone.

July 1, 1891, balance unexpended		$36,941.49
June 30, 1892, amount expended during fiscal year		16,326.97
July 1, 1892, balance unexpended		20,614.52
July 1, 1892, outstanding liabilities	$1,907.10	
July 1, 1892, amount covered by uncompleted contracts	18,178.93	
		20,086.03
July 1, 1892, balance available		528.49
Amount appropriated by act approved July 13, 1892		30,000.00
Amount available for fiscal year ending June 30, 1893		30,528.49
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		412,500.00

(See Appendix A 12.)

13. Kennebec River, Maine.—Before the improvements were commenced the main channel of the river between the foot of Swan Island and Gardiner, was obstructed by shoals near Beef Rock, with only 10 feet of water at mean low tide, by dangerous sunken ledges in Lovejoy Narrows, by a shoal below South Gardiner with only 8 feet on it at mean low tide, and by a ledge at Nehumkeg Island. The steamboat channel to the west of Swan Island (Hatchs Rock) was obstructed by a shoal over which there was only 7½ feet of water, and the channel between Gardiner and Augusta, a distance of 6½ miles, was obstructed by shoals which gave only a navigable depth of 3½ feet of water in low summer tides.

Appropriations were made at various times between 1827 and 1852, for improving the river, but the first regular project was adopted only in 1866 and was for removing rocks and straightening and deepening the upper part of the river. The estimated cost was $50,000.

In 1868 the project was amended so as to give a wider channel, and the estimate was increased to $80,000. In 1871 the project was extended, the additional cost being estimated at $13,000, making the estimate for the entire project $93,000. It was again extended in 1872 to include the removal of ledges in Lovejoy Narrows at an additional estimated cost of $30,603.61. This project was modified in 1873, and as modified was completed in 1877.

In 1881 a project was adopted for the improvement of the channel west of Swan Island, and near the north end of it. The estimated cost of this project, which was completed in 1883, was $20,500.

The harbor and river act of 1886 provided for a new survey of the river from Bath to Augusta. This survey was made in 1887, and a project submitted for the further improvement of the river, giving 12 feet clear depth at low tide up to the Upper Sand Bar, near South Gardiner, 10 feet from thence to Hinckley Shoal, and 8 feet from thence to Augusta; together with an improvement of the steamboat channel west of Swan Island to 9 feet at mean low tide. The estimated cost of this project was $410,500, which estimate was subsequently increased to $428,500.

The total expenditures on the river up to June 30, 1891, have been $280,381.43. By the expenditure of this sum the channel near Beef Rock has been improved to give a clear depth of over 12 feet, the dangerous rocks in Lovejoy Narrows have been removed to a depth of 12 feet, and the channel through the Narrows straightened, the shoal near South Gardiner was deepened from 8 feet to 10 feet, the ledge at Nehumkeg was removed to 12 feet, the steamboat channel west of Swan Island has been deepened to 9 feet, and near the head of it to 10 feet, the channel between Gardiner and Augusta has been deepened to 7 feet between Gardiner and Hallowell, and to 6½ feet between Hallowell and Augusta, and the old piers of the bridge at Hallowell have been removed.

Some shoaling has since taken place between Gardiner and Augusta, and some on the bar below South Gardiner, but on the whole a decided betterment of navigation has been accomplished.

The expenditures for the year ending June 30, 1892, have been $8,411.39, which were applied to the payment of liabilities incurred during the previous fiscal year, and to dredging at Beef Rock, the channel there having filled up. The expenditures of the year ending June 30, 1892, have given a channel not less than 12 feet deep through the bar near Beef Rock, and when the jetty at that place shall have been completed it is expected that this depth will be maintained.

July 1, 1891, balance unexpended		$14,968.57
June 30, 1892, amount expended during fiscal year		8,411.39
July 1, 1892, balance unexpended		6,557.18
July 1, 1892, outstanding liabilities	$314.89	
July 1, 1892, amount covered by uncompleted contracts	3,351.07	
		3,665.96
July 1, 1892, balance available		2,891.22
Amount appropriated by act approved July 13, 1892		100,000.00
Amount available for fiscal year ending June 30, 1893		102,891.22
Amount (estimated) required for completion of existing project		203,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix A 13.)

14. *Harraseeket River, Maine.*—The act approved March 3, 1881, provided that a survey be made of this river. The survey was made in July of that year, and a report submitted in December by the engineer of the district.

The river empties into Casco Bay at Stocksbridges Point, about 12 miles northeast of Portland. From Stocksbridges Point up to Westons Point the depth of water is no less than 10 feet at mean low tide, with no obstructions to navigation.

From Westons Point up to Freeport Landing, a distance of 4,500 feet, the depth diminishes so that for the greater part of the distance the bottom of the river is 3½ feet out of water at mean low tide. The rise and fall of tides here is 9 feet. The project recommended in 1881 was the dredging of a channel not less than 60 feet wide and 3 feet deep at mean low tide, up to Freeport, and a turning basin 180 feet wide at the head of the channel. The estimated cost of the improvement recommended was $13,000.

No appropriation was made for the work, however, and a new survey was ordered in the harbor and river act of 1888. A project for the improvement was submitted January 4, 1889. This project was on a somewhat larger scale than the one previously suggested, and contemplated a depth of channel of 5 feet at mean low tide, which would give about 14 feet at high tide. The estimated cost of the project was $36,000.

The following appropriation has been made: September 19, 1890, $10,000. No work had been done up to the close of the fiscal year ending June 30, 1891, as it was not deemed expedient to expend any money on it until sufficient funds had been appropriated to accomplish some good results, which could not be done with the amount of the first appropriation alone.

There were no expenditures during the fiscal year ending June 30, 1892, and no work was done.

July 1, 1891, balance unexpended	$10,000.00
July 1, 1892, balance unexpended	10,000.00
Amount appropriated by act approved July 13, 1892	16,000.00
Amount available for fiscal year ending June 30, 1893	26,000.00
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	10,000.00

(See Appendix A 14.)

15. Portland Harbor, Maine.—The entrance to the main part of the harbor of Portland or the anchorage has always been good, but prior to the improvements made by the Government the approach to the inner harbor was obstructed by a shoal known as the middle ground, over which the depth was only from 8 to 10 feet at mean low tide, while between it and Stamford Ledge the greatest available depth was only 16 feet. Besides, the best part of the wharf front of the city was exposed to the swell from the Atlantic, which sometimes made it dangerous for vessels to lie at the docks, and the depth along this front was in some places as little as 4 feet, making a part of it unavailable for commercial purposes.

The first work of improvement undertaken by the Government was the construction of the breakwater. This was begun as early as 1836. It was completed in 1874.

The project for the improvement of the harbor by deepening its waters was first undertaken by authority of act of Congress of 1868. The project was at that time to excavate a channel 300 feet wide, through the southern slope of the middle ground, to a depth of 20 feet at mean low tide.

In 1870 the project was amended so as to provide for a channel 400 feet wide, and in 1871 it was again amended so as to provide for a width of 500 feet.

In 1872 the improvement of Back Cove was added to the project, and in December of that year the project was further amended by providing for the dredging of the inner harbor up to the harbor commissioner's lines to a depth of 16 feet. By 1876 all the contemplated improvements had been executed except some dredging in the inner harbor.

In 1881 Congress made an appropriation for the further improvement of the harbor, and a project was adopted looking to the entire removal of the shoal known as the middle ground, at an estimated cost of $160,000. The project was completed in 1885.

In 1886 the board of trade of Portland asked for the further improvement of the harbor to a depth of 29 feet at low tide, and in 1887 this project was adopted, the estimated cost being $135,000. This is the project now in process of execution.

The total amount expended on the harbor up to June 30, 1891, inclusive of all works of improvement, was $505,360.40. These expenditures have resulted in giving, by means of the breakwater, partial protection to vessels lying at the lower wharves, and by means of dredging, an available depth to navigation of 29 feet at mean low tide, a depth sufficient to accommodate the largest class of ocean steamers.

The expenditures during the year ending June 30, 1892, have been $4,302.44, which expenditures have been applied to the widening of the 29-foot entrance to the inner harbor.

July 1, 1891, balance unexpended		$41, 116. 65
June 30, 1892, amount expended during fiscal year		4, 302. 44
July 1, 1892, balance unexpended		36, 814. 21
July 1, 1892, outstanding liabilities	$763. 09	
July 1, 1892, amount covered by uncompleted contracts	33, 856. 74	
		34, 619. 83
July 1, 1892, balance available		2, 194. 38
Amount appropriated by act approved July 13, 1892		30, 000. 00
Amount available for fiscal year ending June 30, 1893		32, 194. 38

(See Appendix A 15.)

16. Channel in Back Cove, Portland, Maine.—Before any work was done toward improving Back Cove there existed no channel properly considered as such. Only the rudiments of an old channel existed, and for the most part even this was nearly dry at low tide.

The first project adopted had for its object the dredging of a channel 100 feet wide and 8 feet deep at mean low tide from Tukeys Bridge to the "stone shed wharves." The estimated cost was $10,000. The project was completed in 1874.

A survey was made in 1886, and a new project adopted having in view the widening of the channel to 300 feet and deepening it to 12 feet at mean low tide, with a turning basin at the upper end. The estimated cost was $180,000. This project is now in process of execution.

The expenditures to the close of the fiscal year ending June 30, 1891, under the existing project amounted to $51,634.31, and these had given a partially completed channel 12 feet deep at low tide, 4,050 feet long, and about 90 feet wide, with a turning basin 400 feet wide at the upper end.

The expenditures during the fiscal year ending June 30, 1892, were only $57.30, and no work was in progress. A contract, however, was made in 1891 for continuing the work, which contract will be commenced about July 1, 1892.

The increased facilities which this channel gives has enabled heavier vessels to reach this part of the harbor, and the increased tonnage of the year 1891 over 1890 was about 6,000 tons.

July 1, 1891, balance unexpended	$24, 615. 69
June 30, 1892, amount expended during fiscal year	57. 30
July 1, 1892, balance unexpended	24, 558. 39
July 1, 1892, amount covered by uncompleted contracts	22, 500. 00
July 1, 1892, balance available	2, 058. 39
Amount appropriated by act approved July 13, 1892	20, 000. 00
Amount available for fiscal year ending June 30, 1893	22, 058. 39

Amount (estimated) required for completion of existing project.......	$83,750.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 16.)

17. Saco River, Maine.—The first work done on the Saco River was in 1827, when an appropriation was made for the erection of piers, placing beacons or buoys, and removing obstructions. Prior to this the depth of water on the bar was only about 2 feet at mean low tide, while much of the river was deeper. The entrance was also dangerous in rough weather, and the numerous projecting rocks and ledges in the river proper, in connection with the swift currents, made its navigation dangerous.

In 1866 a plan was proposed for the improvement of the mouth of the river, and a project adopted in 1867. The project was for the construction of a breakwater at the mouth of the river, the removal of sunken rocks, and the rebuilding of some of the most important piers, against which vessels might drift without damage. The project was completed in 1873 at a cost of $169,275.

Nothing more was done on the Saco until 1883, when a resurvey of the breakwater was made, and a new project submitted for raising and repairing it, and extending it out to Sharps Ledge. The action of Congress indicates that it desired the old breakwater to be repaired and raised, but not extended.

The harbor and river act of 1884 directed a survey to be made of the river. This was done in 1885, and a project submitted for the improvement of the river proper, from its mouth to the head of navigation. In 1886 and 1888 appropriations were made for repairing and raising the breakwater, and for improving the river. In 1890 the two projects were combined, so that the one now in process of execution is for improving the Saco River, including the breakwater, and the construction of a proposed jetty opposite the same.

The expenditures up to June 30, 1891, have been $236,104.72. These expenditures have resulted in constructing a breakwater which for a time gave additional depth of water on the bar and made navigation at the entrance safer, and the construction of piers in the river, which prevented vessels from being swept on the rocks and damaged.

The increased depth required on the bar and in the river can not be expected until the works are further advanced toward completion.

The expenditures during the fiscal year ending June 30, 1892, have been $20,832.50. These have been applied to the construction of the jetty, which has increased the depth somewhat between it and the breakwater, but not on the outer bar. The jetty can be extended further out with the funds now available, and in order to give immediate relief to commerce it is proposed to dredge a channel through the bar while the extension of the jetty is in progress.

July 1, 1891, balance unexpended		$60,670.28
June 30, 1892, amount expended during fiscal year........................		20,832.50
July 1, 1892, balance unexpended		39,837.78
July 1, 1892, outstanding liabilities	$2,609.48	
July 1, 1892, amount covered by uncompleted contracts	14,544.60	
		17,154.08
July 1, 1892, balance available..		22,683.70
Amount appropriated by act approved July 13, 1892........................		25,000.00
Amount available for fiscal year ending June 30, 1893....................		47,683.70

Amount (estimated) required for completion of existing project	$72,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 17.)

18. Kennebunk River, Maine.—The first appropriation for the improvement of the Kennebunk River was made in 1829, and was for repairing the piers at the entrance to the river, which were designed to improve the course and depth of the channel. Subsequent appropriations were made for the repair and extension of the piers and a wharf that had been built near the mouth of the river, at which vessels could tie up when the tides and storms detained them.

In 1876 a project was adopted the object of which was to secure a channel 4 feet deep at low tide (the rise and fall of tide being about 9 feet) up to Kennebunkport, a distance of about 1½ miles. The project completed in 1882.

In 1888 a survey was ordered in the harbor and river act of that year. This was made in 1889, and a project submitted for the repair of the piers and wharf, the latter of which had fallen into decay, and the deepening of the river at Wading Place by the construction of a jetty. This project is now in process of execution.

The expenditures up to June 30, 1891, have been $65,759.27. These expenditures have accomplished the construction and kept in repair the piers at the mouth of the river, the construction and repair of the Government wharf, and the construction of a jetty at Wading Place. These works have made navigation in the river safer and easier, though they have not maintained any material increase of depth.

The expenditures for the year ending June 30, 1892, have been $14,152.44, which were applied to the repair of the wharf and construction of jetty at Wading Place.

There is but little commerce on the river now, but formerly this was the seat of a large shipbuilding industry.

The funds available will complete all contemplated improvements.

July 1, 1891, balance unexpended	$19,332.24
June 30, 1892, amount expended during fiscal year	14,152.44
July 1, 1892, balance unexpended	5,179.80
July 1, 1892, outstanding liabilities	235.00
July 1, 1892, balance available	4,944.80

(See Appendix A 18.)

19. York Harbor, Maine.—A survey of York Harbor was made in August, 1884, in compliance with the requirements of the harbor and river act of July 5, 1884, and a project suggested having for its object the widening of the channel in three bends where the width did not exceed 75 feet and where the tidal currents are very strong. At the points referred to the channel was to be widened by dredging to 10 feet at mean low tide, that being about the ruling depth in the river. The estimated cost of the improvement was $25,000. It was found that the prices on which the estimate was based were too low, so that in 1887 the estimate was increased to $30,000.

In 1888 the estimate was again revised, as it was found that some of the material to be removed, which was supposed to be gravel and bowlders, proved to be solid ledge. The estimate that year was given as $44,000.

The total expenditures up to June 30, 1891, have been $30,972.58. These expenditures resulted in widening and straightening the channel at the bends, giving much better facilities to navigation and rendering it more safe. Before the improvements were begun the channel was very crooked and difficult to navigate on account of the swift currents.

The expenditures during the fiscal year ending June 30, 1892, were $4,027.42, which were chiefly for liabilities incurred during the previous fiscal year. No work was done during the year just ended.

July 1, 1891, balance unexpended	$4,027.42
June 30, 1892, amount expended during fiscal year	4,027.42
Amount appropriated by act approved July 13, 1892	9,000.00

(See Appendix A 19.)

20. Portsmouth Harbor, New Hampshire.—The harbor and river act of 1878 called for a survey of Portsmouth Harbor, with a view to its improvement. The report of the survey was submitted December 12, 1878, and a project of improvement recommended. The project was for the construction of a stone breakwater between Great Island and Goat Island to check the cross currents, which tended to throw vessels on Goat Island Ledge; the removal of Gangway Rock, lying in front of the U. S. navy-yard, to a depth of 20 feet at low tide; and the removal in part of the ledge at the southwest point of Badgers Island to a depth of 10 feet at mean low tide. The estimated cost of the project was $150,000. Work under this project was begun in 1879. The project was completed in 1891.

In addition to the above work the harbor and river act of September 19, 1890, appropriated $13,000 for the removal of a ledge known as Pier Rock. This work also was completed during 1891.

The total expenditures for the improvement of the harbor up to June 30, 1891, were $113,850.94. These expenditures accomplished the construction of the breakwater from Goat Island to Great Island, the removal of Gangway Rock to 20 feet, and a part of Badgers Island Ledge to 18 feet, rendering navigation in the harbor safer than formerly.

The expenditures for the fiscal year ending June 30, 1892, have been $14,569.55, which were applied to completing the removal of Badgers Island Ledge and the removal of Pier Rock to a depth of 12 feet below mean low tide. All the work proposed was completed during 1891, completing the project.

July 1, 1891, balance unexpended	$21,149.06
June 30, 1892, amount expended during fiscal year	14,569.55
July 1, 1892, balance unexpended	6,579.51
July 1, 1892, outstanding liabilities	1,972.12
July 1, 1892, balance available	4,607.39

(See Appendix A 20.)

21. Bellamy River, New Hampshire.—A survey was made of the Bellamy River in 1887, and a project of improvement suggested, at an estimated cost of $28,000.

The project is to secure a channel 50 feet wide and 5 feet deep, at mean low tide, from the mouth of the river up to Sawyer's Mill at Dover. The rise and fall of tide being about 7 feet, a high-water navigation of 12 feet will be secured.

The above project was adopted in 1888, and its execution is now in progress.

The expenditures up to the close of the fiscal year ending June 30, 1891, have been $10,111.52. These expenditures have resulted in giving a channel from the mouth of the river up to about 1 mile above

Roberts's brickyard, 50 feet wide and 5 feet deep at low tide. In other words, about 1 mile was added to the navigable part of the river.

The expenditures during the fiscal year ending June 30, 1892, have been $8.82. This expenditure has not added to the facilities of navigation, but a contract has been made for continuing the dredging from the point where it was stopped the year previous. The work provided for under this contract will add about three-fourths of a mile more to the navigable part of the river.

July 1, 1891, balance unexpended		$9,888.48
June 30, 1892, amount expended during fiscal year		8.82
July 1, 1892, balance unexpended		9,879.66
July 1, 1892, outstanding liabilities	$325.00	
July 1, 1892, amount covered by uncompleted contracts	9,000.00	
		9,825.00
July 1, 1892, balance available		554.66
Amount appropriated by act approved July 13, 1892		7,500.00
Amount available for fiscal year ending June 30, 1893		8,054.66
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		7,500.00

(See Appendix A 21.)

22. *Cocheco River, New Hampshire.*—Before the improvement of the river was begun the river from Dover to the Lower Narrows was much obstructed by bowlders, ledges, and shoals, the depth being in some places as little as 6 inches at mean low tide. The tide here rises and falls about 6.75 feet.

The first regular project for improvement was adopted in 1871, and looked to the forming of a channel 40 feet wide and 4 feet deep from the Lower Narrows up to Collins's wharf. The estimated cost was $45,000. Subsequently more accurate and extended surveys have shown the practicability and importance of extending the improvement up to the head of navigation, and the project was extended and the estimate increased to $85,000.

The project was completed by 1879. The improvements made had opened up a large commerce, employing large vessels where formerly only flatboats had been used, in consequence of which the project was still further extended by providing for a "cut-off" through Alleys Point, widening to 60 feet and deepening to 5 feet the existing channels through Trickeys and Clements shoals, and blasting and removing other obstructions. The extended project was completed in 1888.

In 1889 a new survey was made, in compliance with the requirements of the harbor and river act of August, 1888, and as the large increase of trade seemed to justify still further improvement of the river a new project was submitted, looking to obtaining a depth of 7 feet, increased to 7½ in rock, and a minimum width of 50 feet in rock and 60 to 75 where the material is less expensive to remove. This project was adopted in 1890.

The expenditures up to June 30, 1891, have been $170,215.29. These have resulted in giving a channel through the rocky bed of the river 5 feet deep at low tide, and 40 feet wide in the narrowest parts.

The expenditures during the fiscal year ending June 30, 1892, have been $24,188.83. With the expenditure of this sum the upper end of the channel in front of the wharves at Dover has been deepened to 7 feet at mean low tide, for a length of 1,200 feet, with widths varying from 100 to 140 feet. Portions of the channel above and below Clements Wharf, of a total length of 600 feet, have also been dredged to the same depth.

The improvements in the navigation of the Cocheco have been of great benefit to the people of Dover and the vicinity. In the item of coal alone it is reported that not less than 35,000 tons are supplied annually at a saving of 50 cents per ton, which could not have been done had no improvements been made.

July 1, 1891, balance unexpended	$24,784.71
June 30, 1892, amount expended during fiscal year	24,188.83
July 1, 1892, balance unexpended	595.88
Amount appropriated by act approved July 13, 1892	15,000.00
Amount available for fiscal year ending June 30, 1893	15,595.88
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	135,000.00

(See Appendix A 22.)

23. Harbor of refuge at Little Harbor, New Hampshire.—A survey was made of Little Harbor in 1882, and a plan of improvement proposed, which looked to the opening of a channel of entrance to a depth of 9 feet at low tide, and a width of 100 feet, together with a basin 300 feet by 700 feet, which was to be protected by a rubble stone breakwater. The estimated cost was $33,000. This project was approved in 1886, and its execution entered upon. In 1887 the project was enlarged, as the old one did not seem to meet the requirements of those interested. The enlarged project provided for the construction of two breakwaters, one on the north, the other on the south side of the entrance to the harbor, and the dredging of an anchorage about 49 acres in extent, in the protected area, to a depth of 12 feet at mean low tide. The estimated cost of the enlarged project was $235,000. The project was adopted by Congress in 1888.

Before the improvement was begun the harbor was exposed to the full force of the sea in northeast gales, and the depth of water at the entrance and within the harbor was not sufficient to accommodate even small craft at low tide.

The total expenditures up to June 30, 1891, have been $33,442.44. These expenditures have been applied to dredging part of the area for an anchorage, and to the partial construction of the breakwater on the south side of the harbor.

The expenditures during the fiscal year ending June 30, 1892, have been $8,980.39. This amount has been applied to the breakwater, which has been partly built, but as the contractor refused to go on with his work after certain stone which he was allowed to take from Fort McClary was exhausted, the contract was annulled and the work readvertised. No work was done up to June 30, 1892, under the new contract.

July 1, 1891, balance unexpended		$36,557.56
June 30, 1892, amount expended during fiscal year		8,980.39
July 1, 1892, balance unexpended		27,577.17
July 1, 1892, outstanding liabilities	$50.00	
July 1, 1892, amount covered by awarded contracts	26,640.00	
		26,690.00
July 1, 1892, balance available		887.17
Amount appropriated by act approved July 13, 1892		30,000.00
Amount available for fiscal year ending June 30, 1893		30,887.17

Amount (estimated) required for completion of existing project......$135,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix A 23.)

24. Removing sunken vessels or craft obstructing or endangering navigation.—During the fiscal year two wrecks, endangering navigation, were reported—the schooner *Isabel Alberto*, sunk in Rockland Harbor, Maine, and the schooner *Huntress*, sunk off Browneys Island, to the southwestward of Moosabec Reach, Maine. Steps have been taken looking to the early removal of both obstructions under the provisions of the act of June 14, 1880.

(See Appendix A 24.)

EXAMINATIONS AND SURVEYS, MADE IN COMPLIANCE WITH PROVISIONS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Penobscot River, Maine,* was made by the local engineer in charge, Lieut. Col. Smith, and report thereon submitted. It is his opinion, based upon the facts and reasons given, that this locality is worthy of improvement. This opinion being concurred in by me, Lieut. Col. Smith was charged with and has completed its survey and submitted report thereon.

The works of improvement on Penobscot River proposed in the project submitted are, with estimates of cost, as follows:

1. Improvements near Bangor, Me.:	
Widening channel 60 feet on Brewer side and deepening two areas near ferry landings	$15,280
Removing top of small ledge in front of harbor line off Bacon's Wharf	200
Contingencies and engineering expenses	1,520
	17,000
2. Construction of two jetties near Crosbys Narrows	20,000
3. Construction of three jetties at High Head and Frankfort Flats, between Winterport and Bucksport, Maine	165,000
Total	202,000

In case that an appropriation is made for the improvement of Penobscot River the question of construction of jetties or deepening the navigable channel by dredging should have further consideration.

The reports were transmitted to Congress and printed as House Ex. Doc. No. 37, Fifty-second Congress, first session. (See also Appendix A 25.)

The required preliminary examination of *Kennebec River, Maine, from Waterville to steamboat wharf at Augusta,* was made by the local engineer in charge, Lieut. Col. Smith, and report thereon submitted. It is his opinion, based upon the facts and reasons given, that this locality is worthy of improvement. This opinion being concurred in by me, Lieut. Col. Smith was charged with its survey, which has been completed and report thereon submitted by Lieut. Col. Hains. The cost of securing a 5-foot navigation from the steamboat landing at Augusta to Waterville is estimated at $45,800; the cost of lengthening the lock at Augusta, now the property of a private corporation, so that it could pass vessels of the class that would go up to Waterville, is estimated at $25,000, making the total estimated cost of this improvement $70,800. The reports were transmitted to Congress and printed as House Ex. Doc. No. 76, Fifty-second Congress, first session. (See also Appendix A 26.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN MASSACHUSETTS.

Officer in charge, Lieut. Col. S. M. Mansfield, Corps of Engineers.

1. *Newburyport Harbor, Massachusetts.*—The object of the improvement is to create a channel through the outer bar 1,000 feet wide and with a least depth of 17 feet at mean low water, or 24½ feet at mean high water.

The project, adopted in 1880 and modified in 1883, is to build two converging rubble-stone jetties, so located as to give a proper direction to the current, and thereby produce and maintain the desired result. The estimated cost of the project was $375,000.

The original depth of water on the bar was 7 feet at mean low water.

To June 30, 1891, $234,712.75 had been expended, and the north jetty was 2,675 feet long, of which 2,300 feet had been completed. The south jetty was 1,300 feet long, of which 1,077 feet were completed.

The Plum Island Dike was 817 feet long, 5½ feet high above mean low water (except near the center, where a weir was left temporarily), 150 feet long, and 2 feet above mean low water.

The sand catch in rear of the south jetty was in two branches, one 480 feet long, and one 572 feet.

All these works were in good order.

During the fiscal year 7,166 tons of rubble-stone were deposited in the north jetty, and at the date of this report this jetty is 2,485 feet in length fully completed, and in addition 190 feet are partly completed. The south jetty, the Plum Island Dike, and the sand catch remain essentially as on June 30, 1891.

A survey of the bar was made during the latter part of June, 1892. It showed that the channel across the bar had straightened, widened, and deepened since the survey of 1891. It was now not less than 13.1 feet deep in a navigable channel at least 200 feet wide.

The advantages to be derived from the completion of the project are the deepening and widening of the channel across the bar, thereby affording a harbor of refuge on the inside of Salisbury Beach, and also affording easy access at high water to the wharves at Newburyport for vessels drawing 17 feet, approximately.

July 1, 1891, balance unexpended	$22,787.25
June 30, 1892, amount expended during fiscal year	16,311.04
July 1, 1892, balance unexpended	6,476.21
Amount appropriated by act approved July 13, 1892	20,000.00
Amount available for fiscal year ending June 30, 1893	26,476.21
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	97,500.00

(See Appendix B 1.)

2. *Merrimac River, Massachusetts.*—The object of the improvement is to straighten, deepen, and widen the natural channel of the river from its mouth to the Upper Falls, a distance of 21½ miles.

The channel originally was narrow, crooked, and much obstructed by ledges, bowlders, and shoals; and below Newburyport by ledges, cribs, piers, and wrecks.

At mean low water vessels drawing not to exceed 7 feet could cross the bar and proceed about 6 miles above Newburyport.

The mean rise or fall of the tide at the mouth of the river is 7½ feet; at Haverhill bridge, 4 feet.

The project, originally adopted in 1870, proposed to remove obstructions from the Upper and Lower Falls, to remove Gangway Rock, to remove the wreck of the *Globe*, and to remove the "boilers."

The cost was estimated at $69,025.

This project was revised and extended in 1874 to include the removal of rocks at Deer Island and Rocks bridges, and at Little Curriers Shoal, so that the channel should have the following depths at ordinary high-water stages of the river: From the mouth to Deer Island bridge (5 miles), 16½ feet; thence to Haverhill bridge (12½ miles), 12 feet; thence to the foot of Mitchells Falls (1½ miles), 10 feet; through Mitchells Falls to the head of the Upper Falls (2½ miles), not less than 4½ feet, with the mill water at Lawrence running. This revised project was estimated to cost $147,000.

The total expenditures to June 30, 1891, were $230,866.72, and the river channel had been improved in accordance with the modified project, with the exception of the removal of the "boilers," upon which no work has been done.

No operations were in progress during the year, and the improvement remains in good order.

The funds made available by the act of September 19, 1890, were to be expended at Mitchells Falls, and as they were insufficient for any practicable benefit to commerce, they have been retained in the Treasury.

To complete the improvement so that the same depth of water which has been obtained through Mitchells Falls can be carried to Lawrence, additional work will be required at the falls above Haverhill, which is estimated to cost $11,000; and additional improvements could be made in the lower part of the river, which are estimated to cost $11,500, or a total of $22,500.

The improved channel is in good order.

July 1, 1891, balance unexpended	$10,000.00
June 30, 1892, amount expended during fiscal year	9.48
July 1, 1892, balance unexpended	9,990.52
Amount appropriated by act approved July 13, 1892	1,500.00
Amount available for fiscal year ending June 30, 1893	11,490.52

(See Appendix B 2.)

3. *Powow River, Massachusetts.*—Powow River is a tributary of the Merrimac River, into which it enters from the north about 3½ miles above Newburyport.

From its mouth tide water extends 9,600 feet in a narrow, crooked channel, not navigable at low water.

The project proposed for its improvement is to dredge a channel 9,600 feet long, 60 feet wide, and 12 feet deep at mean high water, at an estimated cost of $77,000.

The river and harbor acts of 1888 and 1890 appropriated $8,000 for this work, provided a suitable draw was built in the bridge which crossed the mouth of the river.

The condition required by the proviso in the acts making appropriations for this improvement has been complied with, but the funds available are inadequate to obtain any appreciable benefit to commerce and they will be retained in the Treasury until additional funds are provided.

No expenditures were made during the year ending June 30, 1892, and the original condition of the river is unaltered.

July 1, 1891, balance unexpended	$8,000.00
July 1, 1892, balance unexpended	8,000.00
Amount appropriated by act approved July 13, 1892	4,000.00
Amount available for fiscal year ending June 30, 1893	12,000.00
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	65,000.00

(See Appendix B 3.)

4. *Ipswich River, Massachusetts.*—Ipswich River empties into Plum Island Sound about 9 miles south of Newburyport, Mass. It is navigable from its mouth to the wharves at Ipswich, a distance of 3 miles. Before improvement, at low water, not to exceed 1½ feet draft could be carried in a narrow channel.

The mean rise or fall of the tide is 8.4 feet.

The object of the improvement is to widen and deepen the natural channel of the river.

The original project was submitted in 1875. It proposed a channel 60 feet wide and 4 feet deep at mean low water.

No expenditures were made during the fiscal year.

Sealed proposals were invited by circular letter dated September 27, 1889, for the completion of the present partial project. No bids were received in response.

On April 10, 1890, bids were again invited by circular letter, and two proposals were received. Both were rejected, as the lowest would make the improvement cost at least twice the amount available, and no advantage to commerce would result from its partial completion.

The work of completing this improvement, as now proposed, has been publicly advertised three times, and it is evident that the small amount of work to be done in this locality, so difficult of access, will cost more than similar work in more accessible places.

The condition of the improvement June 30, 1892, is the same as on June 30, 1891.

The prospective benefits to commerce are increased facilities and safety to navigation.

July 1, 1891, balance unexpended	$2,462.92
July 1, 1892, balance unexpended	2,462.92
Amount appropriated by act approved July 13, 1892	2,500.00
Amount available for fiscal year ending June 30, 1893	4,962.92
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	17,500.00

(See Appendix B 4.)

5. *Harbor of refuge, Sandy Bay, Cape Ann, Massachusetts.*—This bay is situated at the northeastern extremity of Cape Ann, Massachusetts. It is open to the full effect of easterly and northeasterly gales.

The proposed improvement contemplates the construction of a national harbor of refuge of the first class. The anchorage covered by the breakwater will contain 1,377 acres.

The estimated cost of the improvement is $5,000,000.

The original project of 1884 proposed to build only the substructure of the breakwater of rubblestone. The present project, approved March 17, 1892, proposes to build the entire breakwater of rubblestone.

The expenditures to June 30, 1891, were $322,321.37.

The condition of the improvement on June 30, 1891, was as follows: 407,173 tons of rubblestone had been deposited in the substructure, essentially completing it as originally proposed between cross ranges 140 and 4740, under a contract with the Rockport and Pigeon Hill Granite companies. This contract was to expire June 30, 1892, but has been extended three months.

The prospective benefits to commerce and navigation by the construction of this harbor of refuge are, increased safety to life and property and a consequent reduction in freights and insurance.

July 1, 1891, balance unexpended		$127, 678. 63
June 30, 1892, amount expended during fiscal year		77, 020. 52
July 1, 1892, balance unexpended		50, 658. 11
July 1, 1892, outstanding liabilities	$19, 627. 18	
July 1, 1892, amount covered by uncompleted contracts	16, 351. 53	
		35, 978. 71
July 1, 1892, balance available		14, 679. 40
Amount appropriated by act approved July 13, 1892		150, 000. 00
Amount available for fiscal year ending June 30, 1893		164, 679. 40
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		4, 400, 000. 00

(See Appendix B 5.)

6. *Gloucester Harbor, Massachusetts.*—Gloucester Harbor is an important center for the fishing fleet of New England, about 20 miles north of Boston. Its inner harbor was originally obstructed by sunken rocks and shoals, preventing free movement of vessels, and the approaches to the wharves were shallow, varying from 1 to 12 feet. The outer harbor was open to all southerly winds.

The first project submitted in compliance with the act of July 11, 1870, proposed to clear the harbor of sunken rocks and to build a stone breakwater from Eastern Point to Round Rock Shoal. The operations in execution of this general project, under the acts of July 11, 1870, and June 10, 1872, have been confined solely to the removal of isolated sunken rocks specially obstructive to the navigation of the inner harbor.

The act of June 10, 1872, appropriated $10,000, which sum was applied to the removal of Clam Rock, Pinnacle Rock, rock off J. Friend's wharf, rock off Pew's wharf, and a portion of Babsons Ledge.

The act of August 5, 1886, appropriated $5,000 for a survey of the harbor and for continuing work on Babsons Ledge.

The survey was completed in December, 1886, and a report and general project based on this survey were published in the Report of the Chief of Engineers for 1887, page 500.

The revised project proposed to remove from the inner harbor 101½ cubic yards of rock known to exist, and 216,000 cubic yards, scow measurement, of material, at an estimated cost of $65,000; and to construct the breakwater from Eastern Point to Round Rock Shoal, recommended in the project of 1884, at an estimated cost of $752,000.

The amount expended to June 30, 1891, was $24,648.60, and at that date the condition of the improvement was as follows: Clam Rock, Pinnacle Rock, rock off J. Friend's wharf, and rock off Pew's wharf had been reduced to the level of the surrounding bottom, and Babsons Ledge to 14 feet at mean low water. Two channels of approach to the wharves in Harbor Cove had been dredged; each was 40 feet wide and 10 feet deep at mean low water; the eastern one was 550 feet long, the western 1,000 feet long.

During the fiscal year 47,298 cubic yards were dredged from Harbor Cove and the main harbor, and at the date of this report the condition of the improvement is as follows: The channels in Harbor Cove have been widened to 140 feet, 10 feet deep at mean low water. In the main harbor 15 feet depth at mean low water has been obtained in front of the wharves so far as the steamboat wharf, except over four small ledges, uncovered by the dredging near the Halibut Company's wharf. Nothing has been done on the breakwater.

July 1, 1891, balance unexpended	$15,351.40
June 30, 1892, amount expended during fiscal year	12,043.77
July 1, 1892, balance unexpended	3,307.63
Amount appropriated by act approved July 13, 1892	40,000.00
Amount available for fiscal year ending June 30, 1893	43,307.63
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	752,000.00

(See Appendix B 6.)

7. *Manchester Harbor, Massachusetts.*—Manchester Harbor is situated about 5½ miles northeast from the entrance of Salem Harbor, Massachusetts.

Its outer roadstead contains 300 acres approximately, with 5 fathoms of water. Its entrance channel is 100 feet wide and 6½ feet deep at mean low water up to Proctors Point; it then shoals rapidly to a depth of 1½ feet at the "Narrows," 1,400 feet from Proctors Point, and for a further distance of 2,500 feet to the town wharves, no low-water channel exists.

The project for its improvement is based on the survey provided for in the act of August 5, 1886. It proposes to dredge a channel from Proctors Point to the town wharves, 4,000 feet long, 60 feet wide, and 4 feet deep at mean low water, at an estimated cost of $14,300.

The total appropriations for this improvement to date have been $14,300.

The total expenditures to June 30, 1891, were $321.47, and operations were in progress under a contract to dredge 22,000 cubic yards. This contract was satisfactorily completed in July, 1891, by the removal of 22,052 cubic yards.

At the date of this report the improved channel is 35 feet wide, 4 feet deep, at mean low water, from Proctors Point to the railroad bridge, a distance of 2,900 feet.

July 1, 1891, balance unexpended	$7,178.53
June 30, 1892, amount expended during fiscal year	6,800.62
July 1, 1892, balance unexpended	377.91
Amount appropriated by act approved July 13, 1892	6,800.00
Amount available for fiscal year ending June 30, 1893	7,177.91

(See Appendix B 7.)

8. *Salem Harbor, Massachusetts.*—Salem Harbor is 12 miles north-

ward of Boston, Mass. It contains a well sheltered, entirely unobstructed anchorage of about 110 acres, more than 18 feet deep at mean low water.

The principal city wharves are located on South River, a small stream entering the harbor. This river is 3,000 feet long, from 150 to 300 feet wide, and not navigable at low tide.

The original project for the improvement of this harbor was submitted December 16, 1872. It proposed to dredge a channel of approach to the mouth of South River, 1,730 feet long, 300 feet wide, and 8 feet deep at mean low water. This project was essentially completed in 1873–'75.

The present project was submitted December 2, 1889. It proposed to clear out the channel as originally dredged, and to extend it to the head of navigation, gradually reducing its width from 150 feet at the mouth of the river to 100 feet near the inner end of Derby Wharf, and above this to excavate a channel 50 feet wide. To the inner end of Derby Wharf the improved channel to be 8 feet deep at mean low water and above this point, 6 feet deep. The total length of the improved channel to be 5,100 feet approximately.

The total appropriations to date have been $53,000.

The expenditures to June 30, 1891, were $25,073.65. At that date the entrance channel dredged in 1873–'75 had preserved essentially its original dimensions.

During the fiscal year 50,213 cubic yards were dredged and 10 cubic yards of ledge removed from the harbor, and at the date of this report the improved channel is 50 feet wide, 8 feet deep at mean low water to near the inner end of Derby Wharf, and thence, to the head of navigation, 6 feet deep at mean low water.

July 1, 1891, balance unexpended	$13,926.35
June 30, 1892, amount expended during fiscal year	12,708.97
July 1, 1892, balance unexpended	1,217.38
Amount appropriated by act approved July 13, 1892	14,000.00
Amount available for fiscal year ending June 30, 1893	15,217.38

(See Appendix B 8.)

9. *Lynn Harbor, Massachusetts.*—The object of this improvement is to obtain a more direct, wider, and deeper channel of approach to the city wharves. The original channels were narrow and crooked and had but 6 feet depth at mean low water, and the greater part of the harbor was bare at low water.

The project was adopted in 1884. It proposed a channel 200 feet wide and 10 feet deep at mean low water through the outer and inner bars. The outer channel is 3,610 feet long, the inner one 6,450 feet. It is supposed that the inner channel will need occasional dredging. To aid in keeping the outer channel open a training wall is proposed, if experience shall show it to be necessary.

On September 24, 1888, it was proposed to extend the inner channel 400 feet within the harbor line and to excavate at its inner end an anchorage basin 500 by 300 feet in area, 10 feet deep at mean low water, at an estimated cost of $25,000.

The cost of the original project was estimated to be $157,000.

The total expenditures to June 30, 1891, were $75,612.46, of which $66,000 had been expended on the original project.

The condition of the improvement June 30, 1891, was as follows: The outer channel was 3,610 feet long, 200 feet wide, 10 feet deep at mean low water; the inner channel was 6,450 feet long, 150 feet wide, 10 feet deep at mean low water; the anchorage basin was 125 feet wide, 500 feet long, 10 feet deep, connected with the inner channel by a cut 400 feet long, 100 feet wide, 10 feet deep. Nothing had been done on the training wall.

A contract was in force to dredge 40,000 cubic yards from the anchorage basin.

During the year this contract was completed and the interior basin finished as proposed. A survey of the outer improved channel was made, and by comparison with previous surveys it was found that the proposed training wall was not as yet proved to be necessary.

At the date of this report the outer and inner improved channels are in essentially the same condition as on June 30, 1891.

The prospective benefits to commerce are increased facilities and safety to navigation.

July 1, 1891, balance unexpended	$15,387.64
June 30, 1892, amount expended during fiscal year	9,485.77
July 1, 1892, balance unexpended	5,901.87
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	15,901.87
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	81,000.00

(See Appendix B 9.)

10. Winthrop Harbor, Massachusetts.—Winthrop Harbor is situated in the northeastern part of Boston Harbor. It contains 350 acres, approximately, all of which is essentially dry at low tide. The mean range of tides is 9.4 feet.

The original project for its improvement was based on the survey provided for in the act of August 5, 1886. It proposed to dredge a straight channel 3,900 feet long, 50 feet wide, 6 feet deep at mean low water, from the "Back" channel of Boston Harbor to Rice's Wharf.

The total appropriations to date for this improvement have been $9,000.

On June 30, 1891, the improved channel was 35 feet wide, 3 feet deep at mean low water, 3,900 feet long.

No operations were in progress during the fiscal year, and at the date of this report the improved channel is in good order.

July 1, 1891, balance unexpended	$3,618.82
June 30, 1892, amount expended during fiscal year	3,116.62
July 1, 1892, balance unexpended	502.20
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	3,502.20
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	8,600.00

(See Appendix B 10.)

11. Boston Harbor, Massachusetts.—The object of this improvement is, first, to preserve the harbor by protecting the islands and headlands; and, second, to improve it by widening, straightening, and deepening the channels.

The projects adopted for this purpose since 1866 have been mainly in accordance with the recommendations of the United States commissioners, whose labors terminated during that year.

The works of preservation consist of sea walls, aprons, jetties, etc., which protect the shores of the islands and headlands, prevent additional wash into the channels, control tidal scour, and preserve the full height of anchorage shelter for vessels in the roadsteads. Such have been built or repaired at Point Allerton, and the islands of Great Brewster, Lovell, Gallop, Long, Deer, Rainsford, George, and Castle.

The works of improvement have been by dredging and blasting, by which means many dangerous rocks and shoals have been removed and the main ship channel enlarged from 100 feet wide and 18 feet deep at mean low water, so that it is now at least 625 feet wide and 23 feet deep at mean low water.

The following tributary channels have also been improved:

a. Charles River.—The natural channel of this river has been widened, straightened, and deepened, so that from its mouth to Western Avenue Bridge, a distance of 4¾ miles, the channel has a width of 200 feet and a depth of 7 feet at mean low water; thence to Arsenal Street Bridge, 2½ miles, the channel has a least width of 80 feet and a least depth of 6 feet.

b. Fort Point Channel.—This important branch of the main ship channel had a least depth of 12 feet at its entrance, and the channel was narrow and crooked. It has been widened to 175 feet and deepened to 23 feet at mean low water from its mouth to Congress Street Bridge, a distance of 1,900 feet.

c. Hingham Harbor. (See separate report.)

d. Nantasket Beach Channel.—The project adopted in 1880 was to widen and deepen the channel so that it would be at least 100 feet wide and 9½ feet deep at mean low water. The project was completed in 1881 and 1883.

e. Channel between Nixs Mate and Long Island.—This channel had originally 4½ feet depth at mean low water. A cut has been made through the bar 300 feet wide, 15 feet deep at mean low water.

f. Broad Sound.—An obstruction called Barrel Rock was removed in 1869.

The total expenditures to June 30, 1891, were $2,147,449.98.

During the fiscal year ending June 30, 1892, the main ship channel was widened at the west end of Brewster Spit to 625 feet; and at the upper middle to 800 feet. It was extended towards Jeffreys Point, so that from Grand Junction Wharf to just east of Simpson's Patent Dry Docks it is now 275 feet wide, 18 feet deep at mean low water, and thence gradually narrows to 250 feet and shoals to 15 feet to a junction with the same depth off Jeffreys Point.

Repairs were made to the sea wall at Great Brewster Island; the sea wall at Gallops Island was extended 300 feet, and the riprap at Long Island was strengthened.

At the date of this report the several works of preservation are in fair order; the main ship channel is 23 feet deep at mean low water, 1,100 feet wide west of the upper middle, 800 feet wide at the upper middle, 1,000 feet wide at the lower middle, and at least 625 feet wide elsewhere.

The subsidiary channels are in the same condition as at the date of the last report.

Under date of December 23, 1891, the officer in charge submitted a report recommending, for the accommodation of the deep-draft vessels that now seek entrance to this harbor, that the main ship channel be deepened to 30 feet at mean low water, at an estimated cost of $1,500,000. This report was transmitted to the Senate in response to Senate resolution of April 18, 1892, and printed in Senate Ex. Doc. No. 83, Fifty-second Congress, first session.

July 1, 1891, balance unexpended		$156,826.12
June 30, 1892, amount expended during fiscal year		68,901.61
July 1, 1892, balance unexpended		87,924.51
July 1, 1892, outstanding liabilities	$5,992.34	
July 1, 1892, amount covered by uncompleted contracts	23,287.62	
		29,279.96
July 1, 1892, balance available		58,644.55
Amount appropriated by act approved July 13, 1892		300,000.00
Amount available for fiscal year ending June 30, 1893		358,644.55
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		50,000.00

(See Appendix B 11.)

12. Weymouth River, Massachusetts.—Weymouth (Fore) River empties into the southwestern part of Boston Harbor, Mass. For 4 miles it is navigable at low water for vessels drawing 18 feet, and to the head of navigation, an additional 3 miles, at least 3 feet depth is to be found.

The original project for its improvement was submitted December 2, 1889. It proposed to improve the natural channel, so that 6 feet at mean low water could be carried to the head of navigation in a channel 100 feet wide to near Weymouth Landing, thence to Braintree Bridge 80 feet wide, and above the bridge 50 feet wide; the total length of improved channel to be 7,000 feet and to cost $40,000.

The river and harbor act of September 19, 1890, appropriated for this work $10,000.

The total expenditures to June 30, 1891, were $4,468.46, and at that date the improved channel was 5,000 feet long, 40 feet wide, and 6 feet deep at mean low water.

During the fiscal year 5,585 cubic yards were dredged from the river, and at the date of this report the improved channel is 6 feet deep at mean low water, 40 feet wide to Braintree Bridge, and 25 feet wide thence to the head of navigation.

July 1, 1891, balance unexpended	$5,531.54
June 30, 1892, amount expended during fiscal year	5,531.54
Amount appropriated by act approved July 13, 1892	10,000.00
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	20,000.00

(See Appendix B 12.)

13. Hingham Harbor, Massachusetts.—The object of this improvement is to widen and deepen the natural channel, which was 30 feet wide and 4 feet deep, so that it will be 100 feet wide and 10 feet deep at mean low water.

The project was originally proposed in 1874 and was modified in 1885. The original project was estimated to cost $11,000. The project of 1885 was to cost an additional sum of $18,750.

The total appropriations to date have been $29,000, and the expenditures to June 30, 1891, were $25,088.35.

On June 30, 1891, the improved channel had been completed as proposed, excepting the removal of a midchannel ledge near Chandlers Island.

No operations were in progress during the fiscal year, and at the date of this report the improved channel is in good order.

The prospective benefits to commerce are increased facilities and safety to navigation.

July 1, 1891, balance unexpended	$911.65
July 1, 1892, balance unexpended	911.65
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	3,911.65

(See Appendix B 13.)

14. *Scituate Harbor, Massachusetts.*—This harbor is on the west shore of Massachusetts Bay, about 14 miles south of Boston Light.

The object of the improvement is to create a harbor of refuge for vessels bound to Boston from the eastward which are too far south of their true course to clear the dangerous ledges near Minots Ledge Light.

Originally the harbor had a low-water area of about 57 acres, more than 6 acres of which had a depth of at least 3 feet at mean low water. It was entirely open to the action of easterly gales, and its entrance was obstructed by sunken bowlders.

The project adopted in 1880 is to build two breakwaters, one from Cedar Point, on the north side of the entrance, and the other from the First Cliff, on the south side, and to dredge the area inclosed and in front of the entrance. The estimated cost of the improvement is $290,000.

The expenditures to June 30, 1891, were $52,918.73.

The condition of the improvement on June 30, 1891, was as follows:

The north breakwater was essentially completed. Nothing had been done on the south breakwater. The anchorage basin was 350 by 450 feet in area, 7 feet deep at mean low water. The entrance channel was 1,600 feet long, 100 feet wide, 5 feet deep at mean low water. The channel connecting the basin with the town wharves was 2,100 feet long, 25 feet wide, 1 foot deep at mean low water.

During the fiscal year 30,000 cubic yards were dredged from the channel connecting the anchorage basin with the town wharves under a contract dated December 5, 1890; and at the date of this report this channel is 3 feet deep at mean low water and 100 feet wide, except at its upper end, where for a distance of 75 feet it is only 50 feet wide.

The anchorage basin, entrance channel, and north and south breakwaters remain in the same condition as on June 30, 1891.

The prospective benefits to commerce by the completion of this improvement are the creation of an additional harbor of refuge on this much frequented dangerous coast.

July 1, 1891, balance unexpended	$10,761.23
June 30, 1892, amount expended during fiscal year	10,611.23
July 1, 1892, balance unexpended	150.00
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	10,150.00
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	217,500.00

(See Appendix B 14.)

15. Plymouth Harbor, Massachusetts.—Plymouth Harbor is 30 miles south of Boston.

The object of its improvement is to perpetuate the harbor by the preservation of Long Beach, which forms it, and to deepen and widen the channels of approach to an enlarged anchorage basin in front of the town wharves.

The various devices employed for the preservation of Long Beach are described in the Annual Report of the Chief of Engineers for the year 1877.

The original project for improvement was adopted in 1875 and modified in 1877 and 1884. The modified project proposed an improved channel 2,286 feet long, 150 feet wide, and 9 feet deep at mean low water, leading to an anchorage basin 866 feet long, 150 feet wide, and 9 feet deep.

The expenditures to June 30, 1891, were:

For beach protection	$127,553.77
For dredging	42,713.13
Total	170,266.90

The condition of the improvement on June 30, 1891, was as follows: The improved channel was 130 feet wide; the basin was 800 feet long and averaged 150 feet wide; both were 9 feet deep at mean low water. Some repairs were needed on Long Beach.

During the fiscal year 11,676 cubic yards were dredged from the basin, thus completing it. One thousand three hundred feet of the bulkheads protecting Long Beach were repaired.

At the date of this report the basin is completed, the improved channel is 130 feet wide, and Long Beach is in fair repair, but needs additional works of protection at its southern end.

July 1, 1891, balance unexpended	$9,171.39
June 30, 1892, amount expended during fiscal year	6,878.74
July 1, 1892, balance unexpended	2,292.65
July 1, 1892, outstanding liabilities	299 35
July 1, 1892, balance available	1,993.30
Amount appropriated by act approved July 13, 1892	9,500.00
Amount available for fiscal year ending June 30, 1893	11,493.30

(See Appendix B 15.)

16. Wellfleet Harbor, Massachusetts.—Wellfleet Harbor is 12 miles southeast of Provincetown, on Cape Cod Bay.

The object of its improvement is to provide a navigable channel from the inner anchorage, the "Deep Hole," to the town wharves.

The project originally proposed in 1871 was to dredge two channels of approach to the town wharves and to remove several dangerous sunken rocks.

The removal of the sunken rocks was effected by an appropriation provided by the act of June 10, 1872.

The present project is to dredge a channel from the "Deep Hole" to the town wharves, 4,200 feet long, 100 feet wide, and 6 feet deep at mean low water.

The expenditures to June 30, 1891, were $11.339.79.

The condition of the improvement on that date was as follows:

Two hundred and four cubic yards of rocks had been removed from the harbor, and the channel connecting the "Deep Hole" with the town wharves was 25 feet wide, 4 feet deep at mean low water.

No operations were in progress during the fiscal year, as the funds available were not considered sufficient to give any appreciable benefit to commerce.

The condition of the improvement at the date of this report is the same as on June 30, 1891.

July 1, 1891, balance unexpended	$4,649.63
July 1, 1892, balance unexpended	4,649.63
Amount (estimated) required for completion of existing project	22,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B 16.)

17. *Provincetown Harbor, Massachusetts.*—Provincetown Harbor is situated at the extremity of Cape Cod, about 40 miles southeast from Boston Light. It is one of the most valuable harbors of refuge on the Atlantic coast. The entire commerce of New England and a very large local fishing interest are directly benefited by its maintenance, which depends entirely on the preservation of the sandy beaches which inclose it. Since 1826 the project has been a general one, and provides for the preservation of the harbor by building dikes, bulkheads, and sand catches, and extensive planting of beach grass to repair and prevent storm damages to the beaches.

From the nature of the work it can at no time be considered completed. A special dike across House Point Island Flats, to be built contingently, was recommended in the annual report for 1886.

A plan of the harbor was published in the Annual Report of the Chief of Engineers for 1886.

The amount expended to June 30, 1891, was $142,558.47, and at that date operations were in progress for the construction of a bulkhead 2,000 feet long west of Wood End Light. This bulkhead was completed during the year. A total length of 3,213 feet, including spurs, was constructed.

During the fiscal year the breakwater protecting the end of Long Point was extended 150 feet southeast.

At the date of this report the works of preservation are in good order, but additional protection is required at the east end of Long Point to secure the light-house tract.

July 1, 1891, balance unexpended	$8,832.97
June 30, 1892, amount expended during fiscal year	5,049.62
July 1, 1892, balance unexpended	3,783.35
Amount appropriated by act approved July 13, 1892	1,500.00
Amount available for fiscal year ending June 30, 1893	5,283.35

(See Appendix B 17.)

18. *Chatham Harbor, Massachusetts.*—Chatham Harbor is at the eastern end of Nantucket Sound, about 15 miles east of Hyannis, Mass.

Its outer anchorage (Chatham Roads) is a valuable harbor of refuge from northerly and easterly gales. The inner harbor (Stage Harbor) is small, but well landlocked, and has 8 to 12 feet depth at mean low water. Its entrance is obstructed by three bars, on which the greatest depth at mean low water is 4 feet.

The project for the improvement of this harbor, submitted December 19, 1890, proposes to dredge a channel through the three obstructing bars, 6 feet deep at mean low water, 100 feet wide at the inner bar, 150 feet wide at the middle bar, and 200 feet wide at the outer bar, at a cost of $10,000.

The total appropriations to date have been $5,000 by the river and harbor act of September 19, 1890.

The amount expended to June 30, 1891, was $398.81, and the original condition of the harbor remained unaltered.

At the date of this report the improved channel through the middle and inner bars is 6 feet deep at mean low water and 100 feet wide. Not less than 5 feet at mean low water can now be carried into the harbor.

July 1, 1891, balance unexpended	$4,601.19
June 30, 1892, amount expended during fiscal year	4,003.34
July 1, 1892, balance unexpended	597.85
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	5,000.00

(See Appendix B 18.)

IMPROVEMENT OF RIVERS AND HARBORS ON SOUTHERN COAST OF MASSACHUSETTS, IN RHODE ISLAND, AND ON EASTERN COAST OF CONNECTICUT.

Officers in chage, Maj. W. R. Livermore, Corps of Engineers, to December 7, 1891, and Capt. W. H. Bixby, Corps of Engineers, since that date, with Lieut. William W. Harts, Corps of Engineers, under his immediate orders since May 20, 1892; Division Engineer, Col. Henry L. Abbot, Corps of Engineers.

1. *Harbor of refuge at Hyannis, Massachusetts.*—This harbor, before improvement, was an open roadstead, exposed to southerly storms. In the years 1827–1838 a breakwater of riprap granite 1,170 feet long was constructed, covering an anchorage of about 175 acres, the entrance to which has a depth of about 15½ feet. Between the years 1852 and 1882 extensive repairs were made in increasing the width of its base and the size of the stone forming its sides and top.

The depth of water immediately inside the breakwater being insufficient for many vessels that seek the harbor for refuge, the present project of 1884 for the improvement of the harbor contemplates dredging the area protected by the breakwater to a depth of 15½ feet at mean low water at a total further cost estimated in 1884 at $45,662.

Eighty-one dollars and twenty cents was already on hand, $28,000 has been since appropriated, and $22,829.17 has been paid out on this work up to June 30, 1891.

The 15½ foot anchorage area has been increased by about 11 acres, about one-third of the area to be dredged.

At the beginning of the last fiscal year work was in progress, and this work was continued until July 16, 1891, with plant owned by the Government and a hired tug.

About 1.1 acres were dredged in the 15½-foot anchorage area protected by the breakwater.

The balance on hand will be applied to dredging in the area protected by the breakwater.

July 1, 1891, balance unexpended	$5,252.03
June 30, 1892, amount expended during fiscal year	5,246.43
July 1, 1892, balance unexpended	5.60
July 1, 1892, outstanding liabilities	5.60
Amount appropriated by act approved July 13, 1892	6,000.00

Amount (estimated) required for completion of existing project	$11,662.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 1.)

2. *Harbor of refuge at Nantucket, Massachusetts*—This harbor is the only one between the harbors of Marthas Vineyard (Vineyard Haven and Edgartown) and Provincetown, a distance of about 100 miles, except the small harbor of Hyannis, on the north side of Nantucket Sound. It has deep water inside, and the object of improvement is to make it a harbor of refuge for vessels plying between ports north and south of Cape Cod.

Before the commencement of the present work there was a shoal about 1½ miles in width outside the entrance, through which the channel or line of best water was only about 6 feet deep, and very crooked and subject to changes in location.

The present approved project of 1880, as modified in 1885, is to construct jetties of riprap stone, projecting from either side of the present entrance to the harbor, for the purpose of concentrating the strength of the tidal currents and excavating a channel of 15 feet depth by scour, and to complete the work by dredging, at a total cost, as estimated in 1885, of $375,000.

One hundred and seventy thousand dollars was appropriated, and $152,771.78 was paid out on this work up to June 30, 1891; the expenditures resulting in the construction of the west jetty to a point 3,955 feet from the shore, and the east jetty to a distance of 834 feet from its initial point on shore, which is the outer end of the middle of the three northwest spurs built on Coatue Beach some years ago, and the foundation was laid and the jetty partially completed for an additional distance of 191 feet.

At the beginning of the fiscal year work on the east jetty was in progress. This work was continued until August 14. The east jetty was extended about 1,300 feet.

The balance available is to be applied to the further extension of the east jetty and raising low places in the west jetty, together with a little dredging, if necessary.

July 1, 1891, balance unexpended	$17,228.22
June 30, 1892, amount expended during fiscal year	17,114.80
July 1, 1892, balance unexpended	113.42
July 1, 1892, outstanding liabilities	113.42
Amount appropriated by act approved July 13, 1892	25,000.00
Amount (estimated) required for completion of existing project	180,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 2.)

3. *Marthas Vineyard inner harbor at Edgartown, Massachusetts.*—The inner harbor at Edgartown lies in the northern part of the water way or strait that separates Chappaquiddick Island from the east end of Marthas Vineyard. It extends southward about 1½ miles from Chappaquiddick Point opposite Edgartown, and averages about one-fifth of a mile in width.

This harbor is so completely landlocked as to form a safe harbor of refuge for small vessels, but the contracted width of the entrance and the resulting velocity of the tidal currents make it difficult to pass through.

The present project of 1889 provides for the removal to 10 feet depth of a shoal known as the Middle Ground in the central portion of the harbor at a total cost, as estimated in 1889, of $4,500.

Two thousand dollars was appropriated and $13.25 was paid out on this work up to June 30, 1891; these expenditures being for preparations for carrying on the work by hired labor.

During the last fiscal year dredging was commenced on July 16 and continued until August 5, by which about half the shoal was removed.

It is proposed to apply the balance of the funds on hand to the completion of the project.

July 1, 1891, balance unexpended	$1,986.75
June 30, 1892, amount expended during fiscal year	1,920.76
July 1, 1892, balance unexpended	65.99
July 1, 1892, outstanding liabilities	11.39
July 1, 1892, balance available	54.60
Amount appropriated by act approved July 13, 1892	2,500.00
Amount available for fiscal year ending June 30, 1893	2,554.60

(See Appendix C 3.)

4. *Harbor at Vineyard Haven, Massachusetts.*—The plan of improvement of 1887 as modified in 1889 contemplates the protection of the points of land at the entrance to the harbor known as East Chop and West Chop by the construction of jetties and other works along the shore to stop the wearing away of the chops by the action of the storm waves, at a total cost, as estimated in 1882, of $60,000.

Thirty-five thousand dollars was appropriated, and $27,906.86 was paid out on this work up to June 30, 1891; these expenditures resulting in the construction of a wharf and three jetties at West Chop and a track, jetty, and sea wall at the East Chop.

During the last fiscal year work was commenced on August 14 and continued to September 5, by which the jetties and sea wall were extended and strengthened, and about half the needed work completed.

The balance available will be applied to continuing the work of protection, mainly at the East Chop.

July 1, 1891, balance unexpended	$7,093.14
June 30, 1892, amount expended during fiscal year	6,997.17
July 1, 1892, balance unexpended	95.97
July 1, 1892, outstanding liabilities	44.69
July 1, 1892, balance available	51.28
Amount appropriated by act approved July 13, 1892	7,500.00
Amount available for fiscal year ending June 30, 1893	7,551.28
Amount (estimated) required for completion of existing project	17,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix C 4.)

5. *Wareham Harbor, Massachusetts.*—The object of the improvement is to deepen and widen the channel leading from Buzzards Bay to Wareham. The commerce of Wareham is carried on in sailing vessels, and the channel is to be made a beating channel for such vessels. Another object of the improvement is the raising of Long Beach.

Before improvement the ruling depth in the harbor was about 7 feet at mean low water in a narrow and very crooked channel. Long Beach, a narrow sand spit at the mouth of the harbor, was washed and abraded by the waves and currents at high water, and the material was carried into and shoaled the channel inside.

The present approved project of 1880, as modified in 1887, provides for a channel 250 feet wide and 10 feet deep at mean low water from Barney Point down to the entrance to the harbor. Above Barney Point the width of the channel is to be 350 feet, with the same depth—10 feet—as below that point. The plan includes also the raising and strengthening of Long Beach, of which a large portion was submerged at low water, to carry it above the storm waves and currents and to hold it there, in order to prevent the filling of the improved channel above, by material abraded from the beach; the whole at a total cost, as estimated in 1887, of $56,236.

Forty-nine thousand dollars was appropriated, and $44,746.07 was paid out on this work up to June 30, 1891; this expenditure resulting in the completion of the channel in the upper part of the harbor in front of the wharves to its full width, the deepening to 10 feet of the channel for about one-half its width from Barney Point to Wareham, and a portion of Reach No. 9, formerly obstructed by the shoal known as the Middle Ground, and the raising of Long Beach above high-water storm tides, so that the wash of sand into the improved channel inside the beach has been considerably stopped.

The ruling depth of the approaches to Wareham has been increased from 7 to 9 feet, and the channel greatly widened in all the reaches. Vessels of larger draft can be carried to Wareham than formerly. The increase in width of channel is a great help to all vessels in beating in and out of the harbor.

During the last fiscal year work under contract was commenced on June 8, and was in progress at the end of the year, by which the channel was widened at its narrowest points above Barney Point.

The balance available will be applied to continuing the work of dredging and to the building up of Long Beach if necessary.

July 1, 1891, balance unexpended		$4,253.93
June 3 , 1892, amount expended during fiscal year		1,975.11
July 1, 1892, balance unexpended		2,278.82
July 1, 1892, outstanding liabilities	$144.26	
July 1, 1892, amount covered by uncompleted contracts	1,760.00	
		1,904.26
July 1, 1892, balance available		374.56
Amount appropriated by act approved July 13, 1892		7,236.00
Amount available for fiscal year ending June 30, 1893		7,610.56

(See Appendix C 5.)

6. *New Bedford Harbor, Massachusets.*—New Bedford Harbor is an estuary of Buzzards Bay, and is the port of the cities of New Bedford and Fair Haven.

Before improvement the channel had a depth of about 12½ feet at mean low water. Old projects of 1874 and 1877 provided for a channel 300 feet wide and 15 feet deep at mean low water from the deep water just above Palmer Island to the wharves at New Bedford. This work was completed in 1877 at a cost of $20,000.

The present approved project of 1887 provided for a channel 200 feet wide and 18 feet deep at mean low water, at a total cost, as estimated in 1887, of $35,000.

Twenty thousand dollars was appropriated and $12,968.33 was paid out on this work, up to June 30, 1891; this expenditure resulting in the excavation to half width of a channel 100 feet wide and 18 feet deep from the 11-foot bank to the vicinity of the wharves of New Bedford.

During the last fiscal year, work was commenced on November 1 and continued to December 1, by which about 2,000 feet length of channel was widened and deepened.

The work required to complete the existing project is the excavation of the remaining half of the channel 200 feet wide and 18 feet deep, extending from the "11-foot bank" to the vicinity of the wharves at New Bedford, and the removal of a few shoal spots between the "11-foot bank" and Butlers Flats, the southern end of the projected channel.

The balance available will be applied to the continuation of this project.

July 1, 1891, balance unexpended	$7,031.67
June 30, 1892, amount expended during fiscal year	6,568.81
July 1, 1892, balance unexpended	462.86
July 1, 1892, outstanding liabilities	213.79
July 1, 1892, balance available	249.07
Amount appropriated by act approved July 13, 1892	7,500.00
Amount available for fiscal year ending June 30, 1893	7,749.07
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	7,500.00

(See Appendix C 6.)

7. *Westport Harbor, Massachusetts.*—Westport Harbor is an estuary on the coast of Massachusetts, lying between Narragansett Bay, Rhode Island, and Buzzards Bay, Massachusetts. The site of the work is on Horse Neck Point (the north side of the entrance to the harbor.)

Before the commencement of the improvement the site of the present work was a point of sand forming the northern and eastern boundary of the entrance to the harbor, and subject to erosion by the sea and tides.

In 1886 $1,000 was appropriated for special protection of Horse Neck Point. This work was completed in 1887.

The present approved project of 1888 provides for the construction of jetties at the end of Horse Neck Point to stop the wearing of this point and also for a small amount of dredging in the harbor; the whole at a total cost, as estimated in 1888, of $2,000.

One thousand dollars was appropriated and $22.96 was paid out on this work up to June 30, 1891; this expenditure being for preparations for field work.

At the beginning of the last fiscal year no work was in progress. Work was commenced September 10 and continued to October 9, by which the old work at Horse Neck Point was rebuilt and strengthened.

Preparations have been made for carrying on the work by hired labor.

The work required to complete the existing project is the extension of the present jetty and the dredging on the Lions Tongue Shoal.

The balance on hand will be applied to the completion of the existing project.

July 1, 1891, balance unexpended	$977.04
June 30, 1892, amount expended during fiscal year	639.23
July 1, 1892, balance unexpended	337.81
Amount appropriated by act approved July 13, 1892	1,000.00
Amount available for fiscal year ending June 30, 1893	1,337.81

(See Appendix C 7.)

8. *Taunton River, Massachusetts.*—This river rises in Norfolk County, Mass., and empties into Narragansett Bay at Fall River. The object of the improvement is to deepen and widen the channel leading to the city of Taunton, at the head of navigation, so that vessels of 11 feet draft can reach the city at high water.

In its original condition the channel was narrow and obstructed by bowlders, and from Berkley Bridge to Taunton the depth was not, in places, more than 5 feet at mean high water. A vessel of 30 tons burden was as large as could go up to Taunton.

From 1870 to 1879 $63,000 was appropriated to secure 9 feet depth at high water. This work was completed in 1879.

The present approved project of 1880, as modified in 1888, provides for a channel 60 feet wide and 11 feet deep from Weir Bridge to the shipyard, a channel 80 feet wide (100 feet at the bends) and 11 feet deep from the shipyard down to and through the Needles and Briggs Shoal; thence to Berkley Bridge a channel of the same width and 12 feet deep, and from Berkley Bridge to the deep water at Dighton the channel was to be 100 feet wide and 12 feet deep. The depths are estimated from high water. The ledge which crossed the bottom of the river at Peter Point and the numerous bowlders which lay on the bottom and sides of the channel from Taunton to Dighton were to be removed, at a total cost, as estimated in 1888, of $108,000.

One hundred and one thousand dollars was appropriated, and $96,654.31 was paid out on this work up to June 30,1891; this expenditure giving results as follows:

With the exception that but 40 feet of the 60 feet of width could be dredged between the bridge at Weir and the shipyard, on account of interfering with private property, and that on account of the hardness and depth of material at the sides the 80-foot channel was not in all cases dredged to its full width, the channel down to Berkley Bridge had been completed. The channel as proposed between Berkley Bridge and Dighton had been completed, with the exception of removing a small amount of ledge rock uncovered in dredging below Peter Point, and had been cleared of bowlders from Taunton down to Berkley Bridge. The work of removal of the ledge at Peter Point had been completed. The material blasted in the channel had been dredged and deposited in the form of a half-tide dam running from Reuben Island to the west shore of the river, with the view of accelerating the current in the dredged channel off and above Dighton and preventing deposits in this part of the channel. Vessels of 11 feet draft can now reach Taunton, at the head of navigation.

The work of dredging with plant belonging to the Government and a hired tug was in progress at the beginning of the fiscal year. The dredging was commenced at the second shoal above Berkley Bridge and continued up stream. The second reach and a portion of the third were completed.

There remain, to complete the existing project, widening and deepening at a few points above the bridge and the removal of the small amount of ledge rock above referred to.

The balance available is to be applied to continuing the improvement.

July 1, 1891, balance unexpended	$4,345.69
June 30, 1892, amount expended during fiscal year	4,322.67
July 1, 1892, balance unexpended	23.02
July 1, 1892, outstanding liabilities	4.30
July 1, 1892, balance available	18.72
Amount appropriated by act approved July 13, 1892	7,000.00
Amount available for fiscal year ending June 30, 1893	7,018.72

(See Appendix C 8.)

9. *Pawtucket River, Rhode Island.*—This river, otherwise called Seekonk River, is the upper portion of Providence River, and extends from Pawtucket to Providence. Before improvement the channel in the river had a ruling depth of about 5 feet at mean low water.

Between 1867 and 1882, $52,000 was appropriated to dredge the channel to 7 feet depth. This work was finished in 1876.

The present approved project of 1883 provides for the excavation by dredging of a channel 100 feet wide and 12 feet deep at mean low water from the deep water above Red Bridge to the ledge opposite Grant & Company's wharf at Pawtucket; thence the deepening by blasting of a channel through the ledge to Pawtucket Bridge, of the same depth and 40 feet wide, at a total cost, as estimated in 1883, of $382,500.

One hundred and forty-five thousand dollars was appropriated and $126,452.02 was paid out on this work up to June 30, 1891, this expenditure resulting in the securing of a new channel 12 feet deep and 100 feet wide, with wide enlargements at the bends, from the deep water above Red Bridge to within 1¼ miles of the head of navigation, and 60 feet wide and of the same depth to within three-fourths of a mile of the same point.

This completed portion of the channel is already a great benefit to the commerce of the river. A ruling depth of about 6 feet can be carried from the upper end of our present work to Pawtucket.

At the beginning of the fiscal year no work was in progress. Work of dredging was commenced on August 8, 1891, and continued to October 31, by which 70,000 yards of material was removed from the narrowest parts of the channel. Work was done by hired labor using two Government dredges and five scows.

The work yet to be done is to excavate the channel to its full width of 100 feet from Bass Rock to a point opposite Grant & Company's wharf, and to deepen the channel through the ledge to the same depth with a width of 40 feet.

It is proposed to extend the channel towards Pawtucket by dredging and to commence work on the ledge.

The balance available will be applied to continuing the improvement.

July 1, 1891, balance unexpended	$18,547.98
June 30, 1892, amount expended during fiscal year	17,843.10
July 1, 1892, balance unexpended	704.88
July 1, 1892, outstanding liabilities	482.20
July 1, 1892, balance available	222.68
Amount appropriated by act approved July 13, 1892	35,000.00
Amount available for fiscal year ending June 30, 1893	35,222.68

Amount (estimated) required for completion of existing project	$202,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 9.)

10. Providence River and Narragansett Bay, Rhode Island.—The object of this improvement is to furnish a wide and deep channel for foreign and coastwise commerce from the ocean to Providence.

Before the improvement of the river was commenced in 1853 many shoals obstructed navigation, and at one point in the channel, a place called "The Crook," the available low-water depth was but 4½ feet. Between 1852 and 1873, $56,500 was appropriated to secure first 9 and then 12 feet depth of channel. This work was finished in 1873.

The present approved project of 1878, modified in 1882, provides for a channel 25 feet deep and 300 feet wide, suitable for large ocean vessels, extending from Fox Point, in the city of Providence, to the deep water of Narragansett Bay, and for an anchorage basin between Fox and Field Points, 300 feet wide, at a depth of 25 feet; 600 feet wide, at a depth of 20 feet; 725 feet wide, at a depth of 18 feet; 940 feet wide, at a depth of 12 feet; 1,060 feet wide, at a depth of 6 feet, at a total cost, as estimated in 1882, of $675,000.

Five hundred and sixty thousand dollars was appropriated and $533,790.83 was paid out on this work up to June 30, 1891; this expenditure resulting in the completion of the 25-foot channel 300 feet wide, and more than half of the anchorage basins.

At the beginning of the fiscal year work under contract was in progress and was continued until August 10, by which over 87,000 cubic yards of material was removed from the anchorage basins.

There is required for the completion of the existing project the excavation of the remainder of the anchorage basin between the head of Sassafras Point Reach and Field Point.

The balance available will be applied to the continuation of the work according to the project.

July 1, 1891, balance unexpended	$26,209.17
June 30, 1892, amount expended during fiscal year	26,129.67
July 1, 1892, balance unexpended	79.50
July 1, 1892, outstanding liabilities	29.95
July 1, 1892, balance available	49.55
Amount appropriated by act approved July 13, 1892	50,000.00
Amount available for fiscal year ending June 30, 1893	50,049.55
Amount (estimated) required for completion of existing project	65,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 10.)

11. Removal of Green Jacket Shoal, Providence River, Rhode Island.—This shoal is in that part of Providence River which constitutes the harbor of Providence. It lies off the wharves, on the south front of the city, and occupies a part of the harbor that is required for anchorage purposes, covering an area of about 18 acres between the 15-foot curves, and about 30 acres in all.

The present approved project of 1885 provides for the removal of the entire shoal to a depth of 25 feet at mean low water, limiting the work by lines drawn 200 feet from the harbor lines, at a total cost, as estimated in 1885, of $112,346.

Seventy-nine thousand two hundred and fifty dollars was appropriated, and $64,996.56 was paid out on this work up to June 30, 1891; this expenditure resulting in the excavation of an area of about 13¾ acres on the western side of the shoal to a depth of 25 feet at mean low water, making an important addition to the anchorage facilities of Providence Harbor.

At the beginning of the last fiscal year no work was in progress.

Work of dredging under contract was commenced August 12 and continued to October 27, by which about 4.4 acres more of the shoal were removed.

The balance available will be applied to the continuation of the excavation of the shoal.

July 1, 1891, balance unexpended	$14,253.44
June 30, 1892, amount expended during fiscal year	14,235.36
July 1, 1892, balance unexpended	18.08
July 1, 1892, outstanding liabilities	5.90
July 1, 1892, balance available	12.18
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	10,012.18
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	23,096.00

(See Appendix C 11.)

12. Greenwich Bay, Rhode Island.—Greenwich Bay is an arm of Narragansett Bay, located in the towns of Warwick and East Greenwich, R. I. It has a length from northwest to southeast of about 3½ miles and an average width of 1½ miles.

The channel leading to the town of East Greenwich was deep enough for the present demands of commerce, but so crooked as to render navigation difficult.

The present approved project of 1885 provides for the straightening and widening of the channel by the removal of sand bars and shoals, at a total cost, as estimated in 1888, of $2,000.

Two thousand dollars was appropriated, and $1,896.08 was paid out on this work up to June 30, 1891; this expenditure resulting in the practical completion of the proposed work, by cutting off the bar extending out from Long Point about 210 feet and widening the channel for a distance of about 500 feet.

Nothing but minor office work has been done during the past year. Nothing further is needed.

July 1, 1891, balance unexpended	$103.92
June 30, 1892, amount expended during fiscal year	103.60
July 1, 1892, balance unexpended	.32
July 1, 1892, outstanding liabilities	.32

(See Appendix C 12.)

13. Cove and water way near Coaster Harbor Island, Rhode Island.—This cove is situated in the northwestern part of the city of Newport, R. I., near the southeastern extremity of Coaster Harbor Island, which is occupied by the U. S. Navy as a training station. A causeway connecting Coaster Harbor Island with Rhode Island forms the northern boundary of the cove and separates it from the water way above. This causeway, having but one small opening, has checked the flow of water around the island and caused deposits, so filling the water way as to cause it to give forth unhealthy and disagreeable odors.

The present approved project of 1889 proposes to dredge the cove to the necessary depth and to increase the flow of water by larger openings in the causeway, at a total cost, as estimated in 1889, of $5,500.

Five thousand five hundred dollars was appropriated, and $2,266.97 was paid out on this work up to June 30, 1891; this expenditure resulting in the completion of the dredging in the cove and the construction of four small bridge trusses.

At the beginning of the last fiscal year no work was in progress. Work was resumed on June 17, 1892, on the cutting of openings through the causeway, but this work was stopped on the 20th to wait the completion of certain work on the Naval War College at this place, which work required a free passage over the causeway during June and July.

The bridges are framed, and ready to put in position in a short time.

To complete the existing project it is only necessary to cut the causeway and erect the bridges.

July 1, 1891, balance unexpended	$3,233.03
June 30, 1892, amount expended during fiscal year	1,233.94
July 1, 1892, balance unexpended	1,999.09
July 1, 1892, outstanding liabilities	186.65
July 1, 1892, balance available	1,812.44

(See Appendix C 13.)

14. Newport Harbor, Rhode Island.—This harbor is at the main entrance to Narragansett Bay, and all the year it serves as an easily accessible harbor of refuge to foreign and coastwise commerce.

Before improvement the capacity of the inner harbor was limited by shoals, and it was not adequate to the number and size of the vessels seeking it for refuge. The southern or main entrance was obstructed by a bar which stretched out from Goat Island, and the general business wharves of the city could not be reached at low tide by vessels drawing more than 8 feet.

Between 1873 and 1875 $28,500 was appropriated to secure 12 feet depth in the harbor. This work was completed in 1876.

The present approved project of 1880, as modified in 1882, 1883, and 1884, provided for work as follows:

Deepening the south entrance to 15 feet at mean low water and widening it by dredging Goat Island Spit northward to a line drawn from the dolphin which marks the spit to clear the permanent dock at Fort Adams by 100 feet, and by the excavation of a channel 750 feet wide and 15 feet deep at mean low water around and to the eastward of this dolphin; deepening to 13 feet at mean low water the area included between the 13-foot curve on the west, a line drawn from the southwest corner of Perry Mill Wharf to Lime Rock on the south, the harbor line on the east, and a line drawn parallel to and 50 feet from the city wharf on the north; deepening to 10 feet at mean low water the area northwest of a line drawn from Lime Rock through the spindle which is in the southeast part of the harbor, and excavating a channel 10 feet deep at mean low water along and outside the harbor line south to a point opposite the gas company's wharf; and the construction of jetties on the western shore of Goat Island, to arrest the drift of littoral sand and gravel into the entrance of the harbor, at a total cost, as estimated in 1884, of $132,000.

One hundred and four thousand five hundred dollars was appropriated and $103,164.12 was paid out on this work up to June 30, 1891; this expenditure giving results as follows:

The 13-foot anchorage area has been completed. The channel along and outside the harbor line south to a point opposite the gas company's wharf and the 15-foot channel 750 feet wide around and to the eastward of the dolphin on Goat Island Spit, has also been completed. The increase of width to be made between the 15-foot curves at the southern entrance by dredging in the spit south of Goat Island had been completed. The berth for vessels at the quartermaster's wharf at Fort Adams had been deepened to 10 feet at mean low water, and the littoral sand from the outside of Goat Island had been stopped for the present from washing into the channel at the southern entrance of the harbor by the construction of a jetty on the west side of the island. The southern entrance is completed for vessels of 15 feet draft, and of the total area to be dredged within the harbor (about 90 acres) about 66 acres had been completed.

No dredging was done during the last fiscal year for want of funds.

The river and harbor act of 1892, having extended the work of this improvement to include the removal of Goat Island Spit at the southern entrance to the harbor, and the cost of this new work having been estimated at $24,200, the cost of the entire present project will be thereby increased to a total of $156,200.

The work required to complete the existing project is the dredging of the remainder of the narrow strip along the western edge of the 15-foot channel north of the dolphin, the removal of Goat Island Spit to 15 feet depth, and the excavation of the 10-foot anchorage area; also the building of additional jetties outside of Goat Island whenever they may be required to arrest the drift of littoral sand and gravel into the harbor entrance.

The balance available is to be applied to continuing the improvement.

July 1, 1891, balance unexpended	$1,315.88
June 30, 1892, amount expended during fiscal year	1,313.68
July 1, 1892, balance unexpended	2.20
July 1, 1892, outstanding liabilities	.33
July 1, 1892, balance available	1.87
Amount appropriated by act approved July 13, 1892	25,000.00
Amount available for fiscal year ending June 30, 1893	25,001.87
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	26,700.00

(See Appendix C 14.)

15. *Harbor of refuge at Point Judith, Rhode Island.*—Point Judith is the southeastern extremity of South Kingston, R. I., and marks the southwestern entrance to Narragansett Bay. A long ledge, known as Squid Ledge, extends for nearly a mile in a south by easterly direction about 1½ miles west of the Point.

The present approved project of 1889 provides for a harbor of refuge for passing vessels by the construction of riprap breakwaters on Squid Ledge and between the southern extremity of this ledge and Point Judith, at a total cost, as estimated in 1889, of $1,250,000.

Seventy-five thousand dollars was appropriated and $24,671.15 was paid out on this work up to June 30, 1891; this expenditure resulting in the opening up of quarries, building of special plant, and the commencement of the breakwater itself.

A beacon has been established on the outer end of Squid Ledge, and the construction of the two arms extending one to the north and the other to the east of this point commenced.

During the fiscal year work was carried on in the field from July 1 to November 20, by which the center of the breakwater was raised to low-water level and extended outward along both arms, and the Government plant much increased and improved.

It is proposed to apply the balance available and the appropriation asked for to continuing the construction of the breakwater.

July 1, 1891, balance unexpended	$50,328.85
June 30, 1892, amount expended during fiscal year	48,578.59
July 1, 1892, balance unexpended	1,750.26
July 1, 1892, outstanding liabilities	1,135.34
July 1, 1892, balance available	614.92
Amount appropriated by act approved July 13, 1892	75,000.00
Amount available for fiscal year ending June 30, 1893	75,614.92
Amount (estimated) required for completion of existing project	1,100,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix O 15.)

16. *Harbor of refuge at Block Island, Rhode Island.*—This island is about 14 miles east of the eastern end of Long Island and about 10 miles distant from the nearest point of the mainland.

The object of the improvement is to furnish a harbor of refuge for vessels engaged in foreign and coastwise commerce.

Before the construction of the present harbor Block Island had no harbor which afforded protection for decked vessels.

Between 1870 and 1876, $285,000 was appropriated for a breakwater for a harbor for medium-draft vessels, this work being completed in 1878. Between 1880 and 1882, $25,000 was appropriated for an inner basin and the protection of the shore next the breakwater, this work being completed in 1884. In 1884, $15,000 was appropriated for additions to the old breakwater, this money being so spent in 1884–'85.

The present approved project of 1884, as modified in 1888, provided for a harbor of refuge on the eastern side of the island, consisting of an inner harbor or basin for small vessels and an exterior for large ones. This basin was to be about 950 feet square and completely inclosed, with the exception of an opening 100 feet wide, at a total cost, as estimated in 1885, of $75,000. The exterior harbor is made by the old riprap breakwater.

Fifty thousand dollars was appropriated, and $40,554.97 was paid out on this work up to June 30, 1891; this expenditure giving results as follows:

The filling of the gap in the main breakwater had been completed.

The timber jetty, filled with stone, forming the shore end of the western wall of the enlarged inner harbor had been commenced; the north wall had been commenced, and about 140 feet of the wall west of the opening into the harbor had been built to the level of mean high water.

The shoal west of the breakwater had been dredged to a depth of 9 feet from the steamboat wharf to within 100 feet of the north wall.

During the fiscal year work was continued from July 1 to October 17, by which all the walls of the inner harbor had been built to partial height.

The balance on hand will be applied to the continuation of the work under the existing project.

July 1, 1891, balance unexpended	$9,445.03
June 30, 1892, amount expended during fiscal year	9,331.06
July 1, 1892, balance unexpended	113.97
July 1, 1892, outstanding liabilities	91.98
July 1, 1892, balance available	21.99
Amount appropriated by act approved July 13, 1892	24,000.00
Amount available for fiscal year ending June 30, 1893	24,021.99

(See Appendix C 16.)

17. *Pawcatuck River, Rhode Island and Connecticut.*—The navigable part of the Pawcatuck River extends from the town of Westerly to Little Narragansett Bay, and the object of the improvement is to deepen and widen this channel.

Before improvement, the channel was crooked and obstructed by numerous shoals, on some of which there was but 1¼ feet of water at mean low water.

Between 1871 and 1876 $50,000 was appropriated for the excavation of a channel 5½ feet deep at mean low water and 75 feet wide below the wharves and from 35 to 40 feet wide between the upper and lower wharves, this work being completed in 1876. The present approved project of 1885 contemplates the further widening of the channel to 100 feet below the wharves and by an additional width of two cuts of an ordinary dredging machine, or about 40 feet, between the lower and upper wharves; also the deepening of the entire channel to 8 feet at mean low water, at a total cost, as estimated in 1885, of $38,600.

Thirty-eight thousand dollars was appropriated and $27,765.31 was paid out on this work up to June 30, 1891; this expenditure resulting in the completion of the channel from the deep water opposite the village of Lottery to within about a half of a mile of the city wharves, and the removal to a depth of 8 feet at mean low water of ledges at Certain Draw Point and Pawcatuck Rock. The removal of this rock, done in 1889, to an extent of about 3,400 tons and costing about $3,800, was an item not foreseen and not provided for in the original estimate; and consequently this same amount, $3,800, should now be added to the original estimate of 1885, raising it to $42,400 in order to secure the entire amount of dredging originally estimated for.

During the year work was commenced on November 5 and continued to December 18, again commenced June 7 and continued to June 17, by which over 25,000 cubic yards of material were dredged from the channel, extending the full channel to within a quarter of a mile of the city.

The balance available will be applied to the extension of the channel according to the project.

July 1, 1891, balance unexpended	$10,834.69
June 30, 1892, amount expended during fiscal year	10,080.75
July 1, 1892, balance unexpended	753.94
July 1, 1892, outstanding liabilities	595.91
July 1, 1892, balance available	158.03
Amount appropriated by act approved July 13, 1892	3,800.00
Amount available for fiscal year ending June 30, 1893	3,958.03

(See Appendix C 17.)

18. Harbor of refuge at Stonington, Connecticut.—Stonington Harbor lies on the north side of the eastern entrance from the ocean into Long Island Sound, and its breakwaters are for the purpose of making the harbor a harbor of refuge for vessels entering and leaving this eastern entrance of the Sound. Stonington Harbor originally was an open bay unprotected from southerly storms and obstructed by a shoal having a low-water depth of but 6 feet at the shoalest part. Between 1827 and 1831 about $37,000 was spent in constructing piers or breakwaters in the inner harbor for the protection of the general harborage. Between 1871 and 1873 $46,166 was appropriated for a survey of the harbor and for dredging the harbor to 12 feet depth; this work being finished in 1875. Between 1875 and 1879 $112,500 was appropriated for the construction of a western breakwater about 2,000 feet long, extending to 18 feet depth of water, and for dredging the harborage to 12 feet depth inside this breakwater; this work being completed in 1880.

The present approved project of 1880, as modified in 1882, provides for the construction of a similar eastern breakwater at a total cost, as estimated in 1882, of $143,000. The extent of the western end of the eastern breakwater has not yet been fully determined.

One hundred and thirty thousand five hundred dollars was appropriated, and $127,299.80 was paid out on this work up to June 30, 1891; this expenditure resulting in the extension of this eastern breakwater to a total length of 2,377 feet.

The balance on hand will be expended in extending the eastern breakwater farther to the westward.

July 1, 1891, balance unexpended	$3,200.20
June 30, 1892, amount expended during fiscal year	3,161.62
July 1, 1892, balance unexpended	38.58
July 1, 1892, outstanding liabilities	30.46
July, 1, 1892, balance available	8.12
Amount appropriated by act approved July 13, 1892	12,500.00
Amount available for fiscal year ending June 30, 1893	12,508.12

(See Appendix C 18.)

19. Removing sunken vessels or craft obstructing or endangering navigation.—*Wreck of schooner Weybosset.*—From the wreck of this vessel, whose removal was completed in June, 1891, the recovered property was sold for $120 at public auction in July, 1891, and the proceeds covered into the Treasury.

Wreck of schooner Lucy Jones.—This vessel, loaded with brimstone, was sunk by collision in February, 1892, near the Cross Rip Light-ship in eastern Nantucket Sound. Her spars and rigging were in February and March removed to 50 feet depth below low water.

Wreck of schooner Allie Oakes.—This vessel, loaded with lime, foundered in August, 1891, near Hyannis Breakwater, northern Nantucket Sound; and her wreck was removed by contract completed November 17, 1891.

Wreck of schooner Andrew J. York.—This vessel, loaded with paving stone, was sunk by collision in September, 1891, about 7 miles northwest from Nantucket Light; and her wreck was removed by contract completed January 29, 1891.

Wreck of schooner Mary E. Oliver.—This vessel, loaded with feldspar rock, foundered in October, 1891, near Vineyard Haven Harbor, southern Nantucket Sound; and her wreck was removed by contract completed April 20, 1892. The property recovered from the wreck was sold for $304.75 at public auction in May, and the proceeds covered into the Treasury.

Wreck of schooner Python.—This vessel, loaded with marble dust, was sunk by collision in September, 1891, near the bell buoy on Pollock Rip, eastern entrance to Nantucket Sound; and her wreck was removed by contract completed April 7, 1892.

Wreck of schooner Edith T. Gandy.—This vessel, loaded with paving blocks, foundered in October, 1891, about 2 miles southwest of Shovelful Light-vessel, eastern Nantucket Sound; and her wreck was removed by contract completed June 9, 1892.

Wreck of schooner Florence Nowell.—This vessel, loaded with paving stone, was sunk by collision in October, 1891, near Pollock Rip Lightship, eastern entrance to Nantucket Sound; and her wreck was removed by contract completed April 20, 1892.

Wreck of schooner J. B. Woodbury.—This vessel, wrecked in about 1875, was reported in April, 1892, as lying about 2 miles south of the life-saving station at Monomoy, and as endangering the safety of the life-saving boats and other craft. The wreck has been advertised, and bids have been solicited for its removal.

Wreck of schooner Bertha J. Fellows.—This vessel, wrecked in about 1885, was reported in April, 1892, as lying about three-quarters of a mile north of the life-saving station at Monomoy, and as endangering the safety of the life-saving boats and other craft. The wreck has been advertised, and bids have been solicited for its removal.

(See Appendix C 19.)

EXAMINATIONS AND SURVEYS, MADE IN COMPLIANCE WITH PROVISIONS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Major Livermore, and reports thereon submitted through Col. Henry L. Abbot, Corps of Engineers, Division Engineer, Northeast Division. It is the opinion of Major Livermore, and of the division engineer, based upon the facts and reasons given, that these localities are worthy of improvement. The conclusions of these officers being concurred in by me, Major Livermore was charged with and has completed their survey and submitted reports thereon. The reports were transmitted to Congress and printed as executive documents of the Fifty-second Congress, first session.

1. *Menemsha Bight, Massachusetts, an outlet into Vineyard Sound, on the north shore of the island of Marthas Vineyard, with a view of preventing the closing of said inlet.*—The improvement desired at this locality is the formation of a harbor of refuge for light-draft vessels by the construction of jetties and shore protection, estimated to cost $25,000. While this locality is regarded by Major Livermore and Colonel Abbot as worthy of improvement, it is the opinion of these officers that in view of the difficulty of maintaining the improvement and of its large cost the demands of commerce do not justify the work being undertaken at the present time. Printed as House Ex. Doc. No. 60. (See also Appendix C 20.)

2. *Canapitsit Channel, Massachusetts, between the island of Cuttyhunk and Nashawena (Neshawana), with a view of deepening the same and clearing the channel from obstructions to navigation.*—The improvement proposed contemplates removing bowlders and dredging in the channel to a depth of 6 feet at mean low tide. The cost of this work is estimated at $4,800. It will also be necessary to place a beacon on the rocks lying in 12 feet of water to the south of the channel. Printed as House Ex. Doc. No. 59. (See also Appendix C 21.)

IMPROVEMENT OF CONNECTICUT RIVER, MASSACHUSETTS AND CONNECTICUT, AND OF RIVERS AND HARBORS ON LONG ISLAND SOUND, CONNECTICUT AND NEW YORK, AND ON SOUTHERN SHORE OF LONG ISLAND, NEW YORK.

Officer in charge, Col. D. C. Houston, Corps of Engineers.

1. *Mystic River, Connecticut.*—This is a tidal river about 4 miles in length, extending northward from Fishers Island Sound. Its natural depth for the lower 2 miles was 15 feet or more at low tide, in a very crooked and narrow channel; thence for a mile farther, to the village of Mystic, the depth shoaled to about 9 feet.

Above Mystic there has been little navigation. In 1888 an examination of the river was made, and subsequently a project was adopted for dredging to carry the depth of 15 feet at mean low water, with width of 100 feet up to the highway bridge, and to widen five bends in the stream, at an estimated cost of $30,000.

Up to July 1, 1891, $1,644.33 had been expended in dredging to deepen the channel near Mystic; this was the first work done, and the improvement was not then sufficiently advanced to affect navigation or commerce.

During the past fiscal year the channel was deepened to 15 feet at and near Mystic, making an available depth of 15 feet at mean low water up to the village wharves, where the previous depth has been about 9 feet; and the sharp turn at the mouth of the stream was widened by from 25 to 75 feet.

The total amount appropriated for improving Mystic River is $20,000.

Future appropriations will be applied to dredging in accordance with the project.

July 1, 1891, balance unexpended	$8,355.67
June 30, 1892, amount expended during fiscal year	8,130.07
July 1, 1892, balance unexpended	225.60
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	10,225.60
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	10,000.00

(See Appendix D 1.)

2. *Thames River, Connecticut.*—This river is a tidal stream extending from the city of Norwich 15 miles south to Long Island Sound. For 11 miles above its mouth the depth ranges from 13 to 80 feet.

Until 1889 improvements were confined to a stretch of 3½ miles below Norwich, in which the most troublesome bars lay. In 1829 the channel depth over these bars was about 6 feet at mean low water.

In 1836 a project was adopted for making the channel 100 feet wide and 14 feet deep at mean high water (11 feet at low water), by dredging and by building piers.

In 1878 a channel 14 feet deep at low water was projected, and in 1882 a modification was adopted providing for a channel 200 feet wide and 14 feet deep at mean low water, to be obtained by dredging and by building five dikes or training walls along the outer sides of the channel curves. The estimated cost was $208,080, and a balance of $20,000 from previous appropriations was then available. In 1888 the project was extended to include making 16 feet depth as far up as Allyn Point, and 14 feet from there to Easter Point at an additional cost of $40,000.

Up to July 1, 1891, three of the proposed dikes had been completed, and the fourth nearly so; and the channel had an available depth from Norwich to Easter Point (3½ miles) of nearly 12 feet, with width of 75 feet or over; from Easter Point to Allyn Point, 14 feet depth with 175 feet width; below Allyn Point, 16 feet depth with 200 feet width. At extreme high water the depth was sufficient for the commerce of the river, but the channel was too narrow for convenience and safety.

During the past fiscal year the channel for 2 miles above Fort Point (about 3 miles below Norwich) was made fully 12 feet deep, and widened to 100 and 125 feet; from Fort Point to Easter Point (about a half mile) it was deepened to 14 feet at mean low water, facilitating navigation of the upper part of the river.

Future appropriations will be applied to dredging and, if necessary, to repair and extension of the dikes.

July 1, 1891, balance unexpended	$28,901.78
June 30, 1892, amount expended during fiscal year	24,360.83
July 1, 1892, balance unexpended	4,540.95
Amount appropriated by act approved July 13, 1892	*30,000.00
Amount available for fiscal year ending June 30, 1893	34,540.95
Amount (estimated) required for completion of existing project	55,600.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix D 2.)

3. Connecticut River, Massachusetts and Connecticut.—Above Hartford.—From Holyoke, Mass., 34 miles above Hartford, down to Enfield Falls or Rapids, a distance of 18 miles, there is a fair channel 4 to 5 feet deep.

Enfield Rapids extends about 5 miles over a rocky and uneven bed, with a total fall of 32 feet. From the foot of Enfield Rapids to Hartford, a distance of 11 miles, the river bed is broad and sandy, with a channel from 2 to 5 feet deep at low water.

Several years ago the Connecticut River Company constructed a small canal around Enfield Rapids, through which boats of 3 feet draft and 80 feet length can pass.

The several projects under which work has been done have been for dredging at Barbers Landing and for wing dams. In 1878 plans and estimates were submitted for construction of a canal 8 feet deep around Enfield Rapids. These estimates were revised in 1880. The estimated cost of the canal was $1,322,805. It was not considered advisable to commence construction with a less sum than $450,000, which has not yet been appropriated.

Up to the close of the present fiscal year $100,000 has been appropriated for this part of the river, of which $91,059.70 has been expended. All the work done has been dredging, and the construction and repair of 7 wing dams.

No work was done during the past fiscal year.

The last appropriation for this part of the river was made in 1880, and the last work done was repair of wing dams in 1886. Except the fixing and defining of the channel by wing dams, the results of the improvement so far made have not been permanent.

The funds on hand from previous appropriations are sufficient for such repairs and temporary improvement as may be needed during the ensuing fiscal year; no other work is at present contemplated.

---

* Of which $10,000 may be expended in improvement of Shaws Cove, New London Harbor.

July 1, 1891, balance unexpended	$8,940.30
July 1, 1892, balance unexpended	8,940.30

Connecticut River, below Hartford.—Between Hartford and Long Island Sound, a distance of 50 miles by course of channel, the depth on the bars was formerly 5 feet at low water, the worst places being between Hartford and Middletown, a distance of 19 miles, and at Saybrook Bar at the mouth of the river. Dredging was carried on and small wing dams were constructed by private parties, and by a State corporation up to 1868, with no permanent benefit.

In 1868 a project for improvement by the United States was submitted, under which a pile dike was built at Hartford, and annual dredging done on the bars below Hartford, until 1883.

In 1873 a project for the construction of three jetties on Saybrook Bar was adopted. Two of these have been built; the third will probably not be required.

In 1880 a project for permanent improvement of six of the worst bars between Hartford and Middletown was adopted; it contemplated building riprap wing dams, rectifying the banks, and protecting the caving banks by mattresses, at a total estimated cost of $330,487. It was afterwards found necessary to extend the project to include annual dredging at these and other bars, and the extension and repair of the Saybrook jetties.

Two of the contemplated works have been built, a training wall at Hartford Bar, and a wing dam at Glastonbury Bar, their total cost being $40,715.34. In addition to the work included in the estimate of $330,487, the east and west jetties at Saybrook have been extended and repaired, and a channel 130 feet wide and 12 feet deep has been dredged between them, and from $5,000 to $10,000 has been annually expended in dredging to maintain a depth of 9 feet on the bars between Hartford and Saybrook.

Experience has shown that on account of the frequency and height of freshets in this river the permanent works projected in 1880 would be inadequate to maintain the desired depth, or even to materially reduce the amount of dredging annually required. Therefore, in December, 1887, a new project was adopted, confining future operations to the completion of the Saybrook jetties to a height of 5 feet above high water with a top width of 6 feet, and widening the channel between the jetties to 400 feet with a depth of 12 feet at mean low water, at an estimated cost of $80,000, with annual dredging to maintain a 9-foot channel between Hartford and Long Island Sound, at an average cost of $10,000 per year.

In 1890 an extension of the project was adopted to provide for raising the Hartford Dike to about 15 feet above low-water level, at an additional estimated cost of $50,000.

Up to July 1, 1891, riprap dikes had been built at Hartford and Glastonbury Bars, two riprap jetties at Saybrook Bar, at the river's mouth, a channel 130 feet wide and 12 feet deep had been dredged through Saybrook Bar, and channels of 9 feet depth had been made, and as far as practicable maintained by annual dredging.

The Hartford Dike and jetties at Saybrook are in good condition; the jetties have secured the permanency of the entrance channel, and the dike has partly secured the channel at Hartford Bar; the Glastonbury Dike is mostly covered by sand. The channel at the entrance retains nearly full width and depth.

During the past fiscal year dredging was done as far as the funds would admit of to maintain navigable channels in the river; the bars were all deepened during the summer of 1891. No public improvement has been made since the spring freshets of 1892, and the depth on many of the river bars is now less than required.

Future appropriations will be applied to the maintenance of the 9-foot channels, necessary for navigation of the river, to raising the Hartford Dike, and completing the Saybrook jetties, and to widening the channel at Saybrook Bar.

July 1, 1891, balance unexpended	$11,274.67
June 30, 1892, amount expended during fiscal year	10,888.61
July 1, 1892, balance unexpended	386.06
Amount appropriated by act approved July 13, 1892	20,000.00
Amount available for fiscal year ending June 30, 1893	20,386.06
Amount (estimated) required for completion of existing project	110,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 3.)

4. *Duck Island Harbor, Connecticut.*—This harbor is a broad bay on the north side of Long Island Sound, about midway between the harbors of New Haven and New London, a distance of 46 miles in the widest part of the Sound, where there is no sufficient harbor of refuge for general commerce. Duck Island Harbor is large enough for such use, but is naturally unprotected from storms from any southerly quarter.

By order of Congress examinations of this harbor were made in 1883 and 1886, and subsequently a project was adopted for making it a harbor of refuge by constructing three riprap breakwaters, the west one extending westerly from Duck Island, the middle one extending northeasterly from Duck Island, and the east one extending southwesterly from Menunketesuck Point to the east limit of the harbor. The total length of these breakwaters was to be 5,880 feet and their estimated cost is $463,540.

Work under this project was begun in May, 1891, and July 1, 1891; 270 linear feet of the west breakwater had been built; the length was not sufficient to afford any appreciable shelter.

During the past fiscal year the west breakwater was extended 676 feet, making its total length 946 feet, from the west side of Duck Island to a depth of 15 feet at mean low water.

The breakwater and island together afford a limited shelter, which is occasionally used by vessels in storms.

The total amount appropriated for this improvement is $60,000.

It is proposed to continue breakwater construction under future appropriations.

July 1, 1891, balance unexpended	$24,180.98
June 30, 1892, amount expended during fiscal year	22,865.88
July 1, 1892, balance unexpended	1,315.10
Amount appropriated by act approved July 13, 1892	35,000.00
Amount available for fiscal year ending June 30, 1893	36,315.10
Amount (estimated) required for completion of existing project	403,540.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 4.)

5. *Clinton Harbor, Connecticut.*—This harbor is 10 miles west of the mouth of the Connecticut River. Its channel runs for nearly a mile inside of a beach, through which a breach was made about the year 1840, after which the channel shoaled in two places to about 4 feet depth, where it had been 8 feet deep.

The project for improvement adopted in 1882 provided for closing the breach, and if that did not restore the channel depth, for dredging a channel 100 feet wide and 6 feet deep at mean low water through the shoals. The entire cost was estimated at $10,000.

A riprap dike was built across the breach in 1883 and repaired in 1891. The channel depth has not changed since 1882. Nothing was done during the past fiscal year. Dredging with the funds now available was deferred in order not to interfere with oyster beds until the growing season is passed.

Future appropriations should be devoted to completion of the dredged channel as projected.

July 1, 1891, balance unexpended	$3,365.22
June 30, 1892, amount expended during fiscal year	1,782.47
July 1, 1892, balance unexpended	1,582.75
Amount appropriated by act approved July 13, 1892	2,000.00
Amount available for fiscal year ending June 30, 1893	3,582.75
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	1,500.00

(See Appendix D 5.)

6. *New Haven Harbor, Connecticut.*—The original available low-water depth up to the wharves in this harbor was about 9 feet.

The first project for deepening the channel provided for making it 13 feet deep, which was done in 1871. It was widened at different times until 1878, when a project was adopted for dredging a channel 16 feet deep and not less than 400 feet wide. In 1882 a project was adopted for building a dike to extend out from Sandy Point, with an arm parallel to the channel and 3,200 feet long, in order to contract the channel and maintain 16 feet depth on Fort Hale Bar, when that depth should be obtained by dredging.

Up to July 1, 1891, the shore arm and 2,089 feet of the channel arm of the Sandy Point dike had been built; a 16-foot channel from 400 to 700 feet wide had been made and maintained all the way up the harbor to Tomlinson's bridge, except over the Fort Hale Bar, where the depth is but 13 feet.

No work was done during the past fiscal year. The previously dredged channels are in good condition; the dike has settled from 1 to 2 feet in places.

Future appropriations will be applied to dredging and to extension of the dike, if required.

July 1, 1891, balance unexpended	$9,838.45
June 30, 1892, amount expended during fiscal year	9,120.05
July 1, 1892, balance unexpended	718.40
Amount appropriated by act approved July 13, 1892	15,000.00
Amount available for fiscal year ending June 30, 1893	15,718.40
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	48,000.00

(See Appendix D 6.)

7. *Breakwaters at New Haven, Connecticut.*—In 1880 a project was adopted for making a harbor of refuge at the entrance of New Haven Harbor by the construction of two riprap breakwaters; the first to be 3,300 feet long, extending northeasterly from the lighthouse on Southwest Ledge to Quixes Ledge, the second to be 4,200 feet long, extending northwesterly from Luddington Rock. The estimated cost was $1,311,134.

The river and harbor act of August 11, 1888, provided: "And the Chief of Engineers may, if deemed necessary, relocate the western breakwater, and the Secretary of War is authorized, in his discretion, to expend any portion of said sum in commencing its construction." The New Haven Harbor Commissioners proposed a plan for relocation of the western breakwater, which would largely increase the anchorage afforded under the original project, and which would cost about $5,000,000.

There was no doubt of the desirability of increasing the anchorage ground, but the expenditure required by this plan was larger than the present demands of commerce seemed to warrant. A plan was suggested by the officer in charge for changing the location of the western breakwater to the southwest about 6,000 feet, and constructing a breakwater 5,000 feet long, which should start at a point 1,000 feet N. 54° E. from Luddington Rock, and extend S. 54° W. crossing the rock; also for constructing a smaller breakwater from the east shore towards Quixes Ledge, to better protect the harbor from easterly storms, leaving an eastern entrance channel 800 feet wide and 13 feet deep. The cost of these works, in addition to the present estimates of $1,311,134, would be about $840,000.

Upon appropriation of $120,000 by the river and harbor act of 1890, the modifications of project above described were adopted. Further details concerning this plan, and a sketch showing location of proposed works, are printed in the Annual Report for 1889, Part I, pages 60 and 61; also Appendix D 6, pages 675–685.

Up to July 1, 1891, the east breakwater, 3,450 feet long, had been completed, affording considerable shelter to the east side of the harbor, and the middle breakwater from Luddington Rock had been begun, 350 linear feet being built northeastwardly from the rock.

During the past fiscal year the breakwater over Luddington Rock was extended 150 feet northeastwardly and 1,480 feet southwestwardly, making its present length 1,980 feet, under a contract still in progress.

The work is not yet built to full dimensions of cross section, and the length is insufficient to afford much shelter.

With the available funds it is proposed to extend the breakwater southwestwardly, and with future appropriations to complete the projected breakwaters for harbor of refuge.

July 1, 1891, balance unexpended		$119,914.06
June 30, 1892, amount expended during fiscal year		67,285.15
July 1, 1892, balance unexpended		52,628.91
July 1, 1892, outstanding liabilities	$21,169.77	
July 1, 1892, amount covered by uncompleted contracts	22,173.72	
		43,343.49
July 1, 1892, balance available		9,285.42
Amount appropriated by act approved July 13, 1892		120,000.00
Amount available for fiscal year ending June 30, 1893		129,285.42

Amount (estimated) required for completion of existing project....	$1,541,134.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 7.)

8. *Milford Harbor, Connecticut.*—This harbor consists of a broad, open bay, from the head of which a small tidal stream extends three-quarters of a mile inland to the upper wharf. Originally the depth on the bar at the mouth of the river was less than 2 feet at mean low tide; in parts of the river the channel ran nearly bare.

Under the first project for improvement, adopted in 1872, a channel 4 feet deep and 100 feet wide was excavated through the bar, and thence 40 to 60 feet wide to the upper wharf; small jetties were built to protect the east bank from erosion, and two jetties were built to preserve the channel on the bar, at a total cost of $34,000. In 1881 a project was adopted for making the channel through the bar 8 feet deep at mean low water and 100 feet wide, at an estimated cost of $11,000.

The 8-foot channel has been completed to 100 feet width.

July 1, 1891, the channel over the outer bar was in good condition; that from the bar to the upper wharves had shoaled somewhat.

Work was in progress repairing Long Jetty on the east side of the head of the bay.

During the past fiscal year the repairs of Long Jetty were completed as far as seems now required. The condition of channels has not materially changed.

The project for this improvement is completed.

July 1, 1891, balance unexpended	$2,571.95
June 30, 1892, amount expended during fiscal year	2,396.49
July 1, 1892, balance unexpended	175.46

(See Appendix D 8.)

9. *Housatonic River, Connecticut.*—The navigable part of this river extends from Derby, Conn., to Long Island Sound, a distance of 13 miles, and was originally obstructed by several bars upon which the low-water depth was from 3 to 5 feet.

In 1871 a project was adopted for making and maintaining a channel 100 feet wide and 7 feet deep at mean low water, throughout this distance. Besides the necessary dredging, it contemplated building a breakwater east of the channel over the bar at the river's mouth.

A channel of the required depth has been dredged several times through the worst bars.

July 1, 1891, the available depth in the river channel was about 5 feet at mean low water, except at the upper part of the river where dredging was in progress; the breakwater at the mouth had been built 3,290 feet long, and the depth over the outer bar was about 6 feet.

During the past fiscal year the depth in the upper part of the river was made 7 feet at mean low water, and the breakwater was extended 1,282 feet, making its total length 4,572 feet; a section near the shore end of the breakwater, which was injured by heavy storms during the previous winter, was repaired.

The channels in the river have shoaled somewhat by reason of freshets; the channels near the mouth of the river have shifted so as to become crooked.

With the available funds it is proposed to dredge and straighten the channels at and near the mouth; future appropriations will be applied to extension of the breakwater, and to repair and maintenance of river channels.

July 1, 1891, balance unexpended	$40,196.46
June 30, 1892, amount expended during fiscal year	29,151.78
July 1, 1892, balance unexpended	11,044.68
July 1, 1892, outstanding liabilities	5,901.00
July 1, 1892, balance available	5,143.68
Amount appropriated by act approved July 13, 1892	20,000.00
Amount available for fiscal year ending June 30, 1893	25,143.68
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	112,000.00

(See Appendix D 9.)

10. Bridgeport Harbor, Connecticut.—The available depth in this harbor was originally 5 feet at mean low water.

The first project for improvement provided for an 8-foot channel over the outer and inner bars. This was dredged on the outer bar in 1837, and on both bars in 1853. In 1871 a project was adopted for making a channel 12 feet deep and 100 feet wide, subsequently modified to 300 feet, and for building a jetty on the east shore to check the influx of sand.

This was accomplished in 1882, and a new project was adopted for widening to 600 feet the channel from the inner beacon to the Naugatuck railroad wharf, to provide for vessels driven in by bad weather, without blocking the main channel. The estimated cost of the latter project was $60,000; it is very nearly completed. A small area remains near the Inner Beacon, which it is considered desirable to dredge. The project was extended in 1888 to include widening the channel above the railroad wharf in order to relieve the crowding at that point, and was further extended by act of Congress authorizing the expenditure of the appropriation of 1888 toward dredging a 9-foot channel up to the head of the upper harbor, above the bridges, and by the river and harbor act of 1890, which directed the beginning of the breakwater from the Tongue to the Inner Beacon. The total estimated cost of these extensions was $65,000, of which $30,000 has been appropriated.

Up to July 1, 1891, a channel 12 feet deep at mean low water existed from Long Island Sound up to the lower bridge, with widths of from 75 to 600 feet; thence to a point about 1,400 feet above the horse railroad bridge the depth was 9 feet, and width 75 to 90 feet. These channels are constantly used by the commerce of the harbor, which could not exist without them.

Three hundred linear feet of the riprap breakwater from the Tongue to the Inner Beacon had been built.

During the past fiscal year the breakwater was extended from the Tongue to the Inner Beacon, a total distance of 1,165 feet, and the channel above the horse railroad bridge was extended practically to the head of the harbor, with width of 60 feet.

The breakwater has not been built to sufficiently large cross section for permanence, but it affords considerable and important shelter to the harbor and wharves above.

Future appropriations should be applied to extending and widening the channel above the horse railroad bridge, to repairing the harbor channel and widen it above the railroad wharf, and to enlarge the breakwater as projected.

July 1, 1891, balance unexpended	$19,901.35
June 30, 1892, amount expended during fiscal year	18,491.20
July 1, 1892, balance unexpended	1,410.15
Amount appropriated by act approved July 13, 1892	20,000.00
Amount available for fiscal year ending June 30, 1893	21,410.15
Amount (estimated) required for completion of existing project	35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 10.)

11. Black Rock Harbor, Connecticut.—This harbor consists of a bay partly sheltered by Fayerweather Island, and of two small streams extending inland from the head of the bay. The depth in Cedar Creek, the more important of these streams, was from 2 to 4 feet at mean low water, and the channel was narrow and very crooked.

The project for improvement submitted in 1883, including dredging a channel 3,300 feet long, 80 feet wide, and 6 feet deep, to extend up Cedar Creek, and a breakwater from Fayerweather Island to the mainland. The estimated cost was $80,000.

Up to July 1, 1891, the breakwater had been built to the full length, but not to the width and height projected.

The proposed channel had been carried up to the head of the harbor, but with less width in places than the project required. The channel was, however, largely used, and was indispensable to the commerce of the upper part of the harbor.

During the past fiscal year the channel has been repaired, maintained, and slightly widened. It is now practically of the dimensions required by the project.

Future appropriations should be applied to maintaining and extending the channel, and to enlargement of the breakwater as becomes necessary.

July 1, 1891, balance unexpended	$5,117.38
June 30, 1892, amount expended during fiscal year	4,711.75
July 1, 1892, balance unexpended	405.63
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,405.63
Amount (estimated) required for completion of existing project	35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 11.)

12. Norwalk Harbor, Connecticut.—This harbor consists of the tidal part of Norwalk River, extending from Norwalk, Conn., to the river's mouth, a distance of about 3 miles. South Norwalk is on the west bank of the river, about 1½ miles below Norwalk. Originally the depth up to South Norwalk was about 5 feet at mean low water; between here and Norwalk the river bed ran nearly bare.

The first project for improvement contemplated a channel 100 feet wide and 6 feet deep to Norwalk. In 1881 the project was modified to provide for a depth of 8 feet below South Norwalk. The last estimate upon this work placed the cost from commencement at $84,000.

Some parts of the river have required dredging several times.

Up to July 1, 1891, the channel had been made 100 feet wide and 8 et deep up to South Norwalk, and thence to Norwalk 6 feet deep and from 60 to 100 feet wide; it was in fair condition, but had narrowed slightly from washing in at the sides.

This channel was constantly used by the commerce of Norwalk and South Norwalk, to which it was indispensable.

During the past fiscal year dredging was done to repair and maintain the existing channels, and they now have the full depths and widths above mentioned.

The project for this improvement is practically completed; dredging will be needed in small amounts from time to time to maintain the channels.

July 1, 1891, balance unexpended	$4,767.21
Jun 30, 1892, amount expended during fiscal year	4,583,68
July 1, 1892, balance unexpended	183.53

(See Appendix D 12.)

13. *Wilsons Point Harbor, Connecticut.*—This harbor is a bay on the north shore of Long Island Sound, sheltered from all storms except southerly ones. Its natural depth of 16 feet at the mouth shoaled to about 5 feet at low water at the wharves of the New England Terminal Company, a corporation formed to secure water privileges for the Housatonic Railroad system and its connections.

In 1888 $25,000 was appropriated for this improvement as a part of Norwalk Harbor, and a project was adopted for making a channel 300 feet wide and 15 feet deep up to the vicinity of the wharves. The required depth was secured, with width of 400 feet.

In 1890 $30,000 was appropriated for this harbor, and up to July 1, 1891, with a total expenditure of $36,814.21, the channel up to the vicinity of the wharves had been made 15 feet deep at mean low water, and 480 feet wide, with an additional width of 200 feet for 750 feet on the east side near the wharves. This permitted vessels of 15 feet draft to approach the wharves at any ordinary stage of the tide.

During the past fiscal year the channel below the wharves has been further widened by about 220 feet, and a basin has been dredged 200 feet wide and about 1,300 feet long on the west side of the wharves, affording room for vessels to approach that side.

No further public improvement at this harbor is needed, and no further appropriation is required.

July 1, 1891, balance unexpended	$18,215.69
June 30, 1892, amount expended during fiscal year	9,881.99
July 1, 1892, balance unexpended	8,333.70
July 1, 1892, outstanding liabilities	6,212.87
July 1, 1892, balance available	2,120.83

(See Appendix D 13.)

14. *Five Mile River Harbor, Connecticut.*—This harbor is a small inlet over a mile long, and from 300 to 800 feet wide, on the north shore of Long Island Sound. The natural low-water depth at the mouth is about 3 feet, shoaling to zero half way up the harbor.

The project for improvement proposed in a report on a survey made in 1886, and adopted under an appropriation of $5,000, made August 11, 1888, provides for dredging a channel 8 feet deep at mean low water, 100 feet wide, and about 6,000 feet long, extending to the head of the harbor; the cost was estimated at $25,000.

The total amount appropriated for this improvement is $15,000.

Up to July 1, 1891, $4,873.13 had been expended, and a channel 50 feet wide and 1,500 feet long had been dredged, 8 feet deep at mean low water, extending from deep water in Long Island Sound up the harbor. This was used by vessels entering the harbor, but was not extended far enough to afford access to the wharves.

During the past fiscal year the channel has been widened to 60 feet, and extended about 950 feet farther up the harbor, opposite the lower wharves. Private channels have been dredged to these wharves, and the improvement is now used for bringing vessels to the wharves, which previously could not have landed.

Future appropriations will be applied to widening and extending the channel as projected.

July 1, 1891, balance unexpended	$5,126.87
June 30, 1892, amount expended during fiscal year	5,013.83
July 1, 1892, balance unexpended	113.04
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,113.04
Amount (estimated) required for completion of existing project	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix D 14.)

15. Stamford Harbor, Connecticut.—This harbor consists of a bay on the north shore of Long Island Sound, and of the tidal part, about three-quarters of a mile long, of Mill River. The original depth in this part of the river at mean low water was from 1 to 3 feet, gradually increasing in the bay to a depth of 12 feet.

The project for improvement proposed in 1883, and adopted in 1886, provides for dredging a channel 80 feet wide and 5 feet deep at mean low water from the bay to the head of the harbor, at an estimated cost of $20,000.

Up to July 1, 1891, $17,549.02 had been expended in making the channel 80 feet wide or more, for over half its proposed length, and 50 feet wide for the rest of the distance. The improvement admitted of using vessels of greater draft than formerly.

During the past fiscal year the channel was widened at the principal bends, and in the upper part of the harbor, making about 70 feet width nearly to the head of the harbor.

The project is now regarded as completed, further width at the head of the harbor not being immediately necessary.

July 1, 1891, balance unexpended	$3,287.18
June 30, 1892, amount expended during fiscal year	3,226.45
July 1, 1892, balance unexpended	60.73
Amount appropriated by act approved July 13, 1892	15,000.00
Amount available for fiscal year ending June 30, 1893	15,060.73

(See Appendix D 15.)

16. Port Chester Harbor, New York.—This harbor consists of a bay opening into Long Island Sound at the mouth of Byram River, and of the lower part of the river itself, which is navigable for about a mile above its mouth.

The original available depth in the river was not more than a foot at low water, and Salt Rock in the river and Sunken Rock in the bay were considered dangerous obstructions.

The project for improvement, adopted in 1871, provided for the removal of these rocks to 9 and 11 feet depth, respectively, and for the construction of a breakwater at Byram Point, at the mouth of the harbor, the estimated cost being $96,632.

In 1884 the project was extended to provide for dredging a channel 2½ feet deep and from 60 to 100 feet wide from the bay to the vicinity of the village wharves.

In 1888 the project was further modified to omit the removal of Sunken Rock, and to build a breakwater from that rock to Byram Point, which should also serve as a beacon on the rock. A revised estimate, made in 1890 in accordance with the modification, reduced the cost of completion by about $40,000.

Up to July 1, 1891, $30,941.13 had been expended in removing Salt Rock to 9 feet depth, in dredging a channel 2½ feet deep and from 60 to 100 feet wide to within 150 feet of Port Chester Bridge, with 25 feet width to the bridge, and 585 linear feet of the breakwater from Sunken Rock to Byram Point were constructed.

The dredging and rock removal have resulted in admitting safely vessels of greater draft than formerly. The partial completion of the breakwater has served to mark Sunken Rock and to shelter a small anchorage area at the mouth of the river.

During the past fiscal year nothing has been done. The previous improvements remain in good condition.

Future appropriations will be applied to completing the breakwater, and to maintaining or enlarging the dredged channel.

July 1, 1891, balance unexpended	$1,058.69
June 30, 1892, amount expended during fiscal year	446.67
July 1, 1892, balance unexpended	612.02
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,612.02
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	15,000.00

(See Appendix D 16.)

17. Larchmont Harbor, New York.—This is a bay about half a mile wide and extending three-quarters of a mile inland, with depths gradually diminishing from 18 feet at and near the mouth. The mouth of the bay was obstructed by two rocks (Umbrella Rock and Huron Rock), always covered, and owing to its width the harbor anchorage was little protected from easterly and southerly storms.

A survey was ordered by Congress in 1888, and afterwards a project was adopted for connecting Umbrella Rock with the west shore, and Huron Rock with the east shore by riprap breakwaters, which would sufficiently mark the rocks and would cover the harbor. The estimated cost of the project was $105,000.

Up to July 1, 1891, $4,619.05 had been expended in constructing 74 linear feet of Umbrella breakwater, and 64 linear feet of Huron breakwater, the location being over the rocks. The breakwaters serve to mark the rocks, but are not long enough to afford any appreciable shelter.

No work has been done during the past fiscal year.

Future appropriations should be applied to completing the breakwaters.

July 1, 1891, balance unexpended	$414.28
June 30, 1892, amount expended during fiscal year	293.33
July 1, 1892, balance unexpended	120.95
Amount (estimated) required for completion of existing project	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 17.)

18. Echo Harbor, New Rochelle, New York.—The channel of this harbor was obstructed by two ledges, Start Rock and Sheepshead Reef, the former bare at low water, the latter covered to a depth of about a foot.

The project for improvement, adopted in 1875, provided for the removal of these rocks to 7 and 9 feet depth, respectively. The estimated cost was $38,955.38.

Twenty-two thousand dollars has been appropriated for this harbor, all of which has been expended.

Start Rock has been wholly removed to 7 feet depth, Sheepshead Reef partly removed to 9 feet depth, and a narrow channel has also been dredged up the harbor.

The removal of Start Rock and the channel dredging improved the approaches to the wharves. The work done upon Sheepshead Reef is of little use until the whole reef is removed.

During the past fiscal year nothing has been done.

Future appropriations should be applied to removing the remainder of Sheepshead Reef.

Amount (estimated) required for completion of existing project	$17,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 18.)

19. East Chester Creek, New York.—This is a small tidal stream, emptying into Pelham Bay. It was navigable at high tide only for vessels drawing 7 feet up to Lockwood, a distance of 2¼ miles. The rise of tide is 7.1 feet.

The project for improvement, adopted in 1872, and subsequently modified, provided for a channel 9 feet deep at mean high water, extending to a point 3,000 feet above Lockwood, and terminating at the upper end in a tidal basin. Part of the lower course of the channel was to be protected by dikes, and the whole work was estimated to cost $221,000.

In 1891 this estimate was revised and reduced by omitting the dikes, which seemed unnecessary for maintenance of channels, making the total estimate of cost from beginning $124,000.

Up to July 1, 1891, $64,000 had been appropriated for this improvement, of which $56,858.97 had been expended in dredging and rock removal to make a channel 9 feet deep at high water (2 feet at low water), with width of 125 feet to the head of Goose Island, one-half mile from the mouth of the creek; thence to Town Dock, with width of 100 feet; thence to Lockwood, with nearly the same width. Above Town Dock 1,235 linear feet of diking was built to sustain the sides of the channel. The increased depth and straighter courses resulting have been of benefit to the commerce at Town Dock and Lockwood.

No work was done during the past fiscal year.

A lay-out for the channel above Lockwood was surveyed in 1889, and an effort was then made to obtain consent of owners to the depositing of material to be dredged upon the adjacent marsh lands. This consent has finally been obtained, and dredging with available funds is proposed as soon as the drawbridge at Lockwood can be put in working order.

Future appropriations should be applied to completing the proposed cut above Lockwood and to repairing and maintaining previously dredged channels. A revised estimate, submitted with the last annual report, places the cost of completing this work at $55,000.

July 1, 1891, balance unexpended	$7,141.03
July 1, 1892, balance unexpended	7,141.03
Amount (estimated) required for completion of existing project	55,000.00

{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix D 19.)

20. Greenport Harbor, New York.—This harbor, at the eastern end of Long Island, is exposed to easterly storms; its anchorage ground, which was sheltered by Joshua Point, has materially shoaled by the erosion of the point, and by the influx of drifting sand.

The project of improvement, adopted in 1882, provided for the construction of a riprap breakwater extending from Joshua Point 1,700 feet in a southeasterly course to arrest drifting sand, to check the erosion of the point, and to increase the sheltered area. Its cost was estimated at $46,000.

In 1890 the project was modified to provide for increasing the height of the breakwater from 3 to 5 feet above high water, instead of extending it, and to apply the rest of the estimated amount for completion to dredging and enlarging the anchorage basin.

Up to July 1, 1891, $35,000 had been appropriated to this improvement, and $32,047.20 expended in building 1,570 linear feet of breakwater, and partly increasing the height. The effect has been to check the erosion of Joshua Point, and to afford complete shelter to the inner part of the harbor.

During the past fiscal year the work of increasing the height of the breakwater was completed; dredging was done to increase the sheltered area of 9 feet depth by about 1½ acres, and an entrance channel to Stirling Basin, at the head of the harbor, was dredged 40 feet wide and 6 feet deep to provide access to the winter anchorage ground there.

Future appropriations will be applied to dredging, to increase the area of sheltered anchorage.

July 1, 1891, balance unexpended	$4,505.85
June 30, 1892, amount expended during fiscal year	4,312.94
July 1, 1892, balance unexpended	192.91
Amount appropriated by act approved July 13, 1892	11,000.00
Amount available for fiscal year ending June 30, 1893	11,192.91

(See Appendix D 20.)

21. Harbor of Port Jefferson Inlet, New York.—This harbor is a large and deep inland bay, with a narrow entrance or inlet, outside of which was originally a shoal with 3 feet depth at low water. The location of the inlet is one of the most exposed on Long Island Sound.

Under a project adopted in 1871, and modified in 1873 and 1877, an east jetty 1,390 feet long, and a west jetty 940 feet long, were built, both with scant cross section, and a channel 8 feet deep and 100 feet wide was dredged through the bar. The work was completed in 1883, at a total cost of $79,000.

By order of Congress an examination of Port Jefferson Inlet was made in 1888, and subsequently a project was adopted for repairing and enlarging the jetties and dredging to make the channel 10 feet deep and 200 feet wide, at an estimated cost of $90,000.

Under the existing project, up to July 1, 1891, $2,662.18 (including outstanding liabilities) had been expended in raising and enlarging a part of the east jetty; the effect has been to increase the shelter at the inlet.

During the past fiscal year both jetties were further enlarged, and a contract was entered into for dredging between them, which is still in progress, a small amount of work only being yet done.

With the funds now available the channel will be made 10 feet deep and about 100 feet wide, under a contract now in operation.

Future appropriations will be applied to dredging and enlarging jetties.

July 1, 1891, balance unexpended		$25,047.89
June 30, 1892, amount expended during fiscal year		14,949.11
July 1, 1892, balance unexpended		10,098.78
July 1, 1892, outstanding liabilities	$591.27	
July 1, 1892, amount covered by uncompleted contracts	8,108.73	
		8,700.00
July 1, 1892, balance available		1,398.78
Amount appropriated by act approved July 13, 1892		10,000.00
Amount available for fiscal year ending June 30, 1893		11,398.78
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		55,000.00

(See Appendix D 21.)

22. *Huntington Harbor, New York.*—This is a tidal inlet extending southward from Huntington Bay to the village of Huntington. It is about 2 miles long, quite narrow, and landlocked, and has a natural available depth of nearly 8 feet at mean low water, up to within three-fourths mile of the head of the harbor, where the low-water depth shoaled gradually to zero.

In 1872-'73 a channel 8 feet deep and 150 feet wide was dredged in the upper part of the harbor by the United States at a cost of $22,500. Within ten years following this had nearly filled up.

In 1884 a survey was ordered by Congress, and subsequently a project for improvement was adopted, providing for re-dredging a channel 8 feet deep and 100 feet wide up to the upper wharves, at an estimated cost of $42,000. The estimate also includes a pile protection for part of the channel.

July 1, 1891, a contract for dredging had been entered into, but work had not been begun.

During the past fiscal year a channel 8 feet deep at mean low water, 90 feet wide and about 2,900 feet long, has been dredged from deep water nearly to the upper wharves of the harbor, making these wharves accessible to vessels of moderate draft at all stages of tide.

Future appropriations will be applied to dredging to widen the channel, and to maintenance of the channel already dredged.

July 1, 1891, balance unexpended	$9,895.60
June 30, 1892, amount expended during fiscal year	9,486.39
July 1, 1892, balance unexpended	409.21
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,409.21

Amount (estimated) required for completion of existing project........	$17,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 22.)

23. Glen Cove Harbor, New York.—This harbor is an inlet on the east side of Hempstead Bay, which is accessible only at high tide, and a breakwater was needed to shelter vessels while at anchor waiting for tides.

The project for improvement, adopted in 1888, provides for a riprap breakwater about 2,500 feet long, extending in a west-southwesterly direction from the northwest corner of the Glen Cove Dock, the top to be 5 feet wide and 3 feet above mean high water, and slopes to be 1 on 1. Its estimated cost was $201,960.

Up to July 1, 1891, 824 linear feet of breakwater had been built at a cost of $22,788.23, affording a small area of shelter in shoal water close to the landing.

During the past fiscal year the breakwater was extended 232 feet farther, making its total length 1,056 feet. The cross section has been made less than designed for permanency to allow of securing more shelter with the available funds.

The project provides for about 1,450 feet extension of the breakwater, which will be built as funds for the purpose are appropriated.

July 1, 1891, balance unexpended	$14,739.30
June 30, 1892, amount expended during fiscal year........................	14,501.93
July 1, 1892, balance unexpended....................................	237.37
July 1, 1892, outstanding liabilities....................................	16.00
July 1, 1892, balance available....................................	221.37
Amount appropriated by act approved July 13, 1892....................	10,000.00
Amount available for fiscal year ending June 30, 1893....................	10,221.37
Amount (estimated) required for completion of existing project........	156,960.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 23.)

24. Flushing Bay, New York.—Before improvement, the available depth in this broad shallow bay and in the channel leading up to Flushing was less than 4 feet at mean low water.

The project for improvement, adopted in 1879, contemplated building 16,700 feet of diking to form a tidal basin, which, by filling and discharging through the main channel, would maintain a channel depth of 6 feet or more at mean low water, after once dredging; the bottom is soft mud. The estimated cost of this work was $173,500.

In 1888 the project was modified to omit part of the diking, which then appeared unnecessary, and in 1891, at the request of many citizens, the extension of dikes was wholly omitted from the project.

Up to July 1, 1891, $89,612.08 had been expended in building 4,663 linear feet of diking, and in dredging and redredging to make and maintain a channel of 6 feet depth at mean low water. The channel is of great use to the commerce of the bay; it will probably require annual dredging to maintain it.

During the past fiscal year 73,849 cubic yards of mud was removed, making a 6-foot channel 90 feet wide and about 5,200 feet long; the depth actually made was somewhat greater, to allow for filling in.

It is proposed to apply future appropriations to dredging, to maintain and widen the 6-foot channel.

July 1, 1891, balance unexpended	$15,500.02
June 30, 1892, amount expended during fiscal year	15,217.38
July 1, 1892, balance unexpended	282.64
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	10,282.64
Amount (estimated) required for completion of existing project	58,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 24.)

25. Patchogue River, New York.—This is a shallow tidal inlet extending about a mile northward from the shore of Great South Bay, Long Island, to the village of Patchogue. The natural depth in the stream and over a bar at the mouth was from 2 to 3 feet at mean low water, and the rise of tide is about 1 foot.

In 1880, and again in 1886, examinations were made by order of Congress, and subsequently a project was adopted for making a channel, 6 feet deep at mean low water and 60 feet wide, up to the village wharves, to be protected at the mouth by a jetty on the west side, at an estimated cost of $40,000.

Up to July 1, 1891, $1,541.18 (including outstanding liabilities) had been expended in building 150 linear feet of the shore end of the jetty.

During the past fiscal year 1,190 linear feet of the jetty were built, making its length 1,340 feet; and a channel, 6 feet deep and 50 feet wide, was dredged from deep water in Great South Bay to and inside the entrance to the river; this channel will require partial redredging to make it permanent. It does not yet extend far enough up the river to be of great use to navigation.

Future appropriations will be applied mainly to dredging.

July 1, 1891, balance unexpended	$14,843.82
June 30, 1892, amount expended during fiscal year	13,584.83
July 1, 1892, balance unexpended	1,258.99
July 1, 1892, outstanding liabilities	77.37
July 1, 1892, balance available	1,181.62
Amount appropriated by act approved July 13, 1892	8,000.00
Amount available for fiscal year ending June 30, 1893	9,181.62
Amount (estimated) required for completion of existing project	17,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 25.)

26. Browns Creek, Sayville, New York.—This is a narrow stream extending northward from Great South Bay to the Sayville highway bridge, above which it is wholly a fresh-water creek. The natural
pth in the creek is from 1 to 3 feet at low tide, and on a bar at the
uth it is less than 1 foot.

survey was made by order of Congress in 1889, and a project was
pted for making the creek 100 feet wide and 4 feet deep at mean
water, the entrance channel to be protected by riprap jetties on
er side, at a total estimated cost of $46,000.

he total amount appropriated for this work is $17,000.

uly 1, 1891, a contract had been entered into for commencing the
ies but work had not been begun.

uring the past fiscal year 492 feet of the west jetty was built and

450 feet of the east jetty partly built, under a contract not yet completed.

A channel 100 feet wide and 4 feet deep at mean low water was dredged from deep water in Great South Bay, extending between the jetties and up the stream; the total length of channel is 1,450 feet, and total amount dredged 23,194 cubic yards. In addition, private channels have been dredged into the marsh on the east side of the main channel, with width of 25 and 50 feet and aggregate length of 1,500 feet.

Prior to 1891 this creek was of no value for purposes of navigation. It is now quite extensively used by boats engaged in oystering, etc.

Future appropriations will be applied to maintaining and extending the dredged channel and to such repairs and extension of the jetties as become necessary.

July 1, 1891, balance unexpended		$11,929.16
June 30, 1892, amount expended during fiscal year		10,457.76
July 1, 1892, balance unexpended		1,471.40
July 1, 1892, outstanding liabilities	$537.60	
July 1, 1892, amount covered by uncompleted contracts	560.00	1,097.60
July 1, 1892, balance available		373.80
Amount appropriated by act approved July 13, 1892		5,000.00
Amount available for fiscal year ending June 30, 1893		5,373.80
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		29,000.00

(See Appendix D 26.)

IMPROVEMENT OF HUDSON RIVER; OF HARBORS AT SAUGERTIES AND RONDOUT, AND WAPPINGER CREEK; OF NEW YORK HARBOR AND RIVERS AND HARBORS IN ITS VICINITY, NEW YORK; AND OF RARITAN BAY, NEW JERSEY.

Officer in charge, Lieut. Col. G. L. Gillespie, Corps of Engineers, having under his immediate orders Lieut. Harry Taylor, Corps of Engineers, to November 2, 1891, and Lieut. James G. Warren, Corps of Engineers, since August 12, 1891.

1. *Hudson River, New York.*—The improvement of this river has been restricted by the wording of the appropriation acts to that part of it lying between Troy, at the head of navigation, 6 miles above Albany, and New Baltimore, about 14 miles below Albany.

Before the improvement was begun the navigable depth in the channel between New Baltimore and Albany was 7½ feet at mean low water; between Albany and Troy, 4 feet.

The mean range of tides at State dam at Troy is 0.80 feet; at Albany, 2.32 feet; and at New Baltimore, 3.42 feet.

The plan of improvement adopted in 1867 proposed making the navigable depth between New Baltimore and Albany 11 feet, and between Albany and Troy 9 feet. This was to be accomplished by the construction of longitudinal dikes to direct the currents, and by dredging.

The estimated cost of making this improvement, prepared in 1882, subject to be increased annually, was $1,078,304. In 1889 the estimated cost was $1,424,435.

The amount expended to June 30, 1891, inclusive of outstanding liabilities, was $1,162,011.70, of which sum a large part has, however, from the necessities of the case, been applied partly to the repair of decaying dikes and partly to dredging. At that date the dikes provided for in the project of improvement, so far as built, had resulted in securing a channel depth of 10 feet nearly all the way from New Baltimore to Albany, and of 8 feet nearly all the way from Albany to Troy. The shoal spots make the navigable depths on those parts of the river 9½ feet and 7½ feet, respectively.

The amount expended during the fiscal year ending June 30, 1892, inclusive of outstanding liabilities, was $96,962.43, and was applied to the repairs of the dikes; to the construction of new dikes; to dredging at Fish House, Bogart Light, Winnies, and Washington bars; to the removal of Dettingers Rock, opposite Van Wies Point; to the partial removal of the Overslaugh Rock, above Van Wies Point, and to the removal of wrecks from navigable channel under improvement.

The river and harbor act approved September 19, 1890, provides as follows:

> That the Secretary of War is authorized and directed to appoint a board of three officers of the Corps of Engineers, United States Army, whose duty it will be to thoroughly examine the obstructions to navigation in the Hudson River, between New York City and the State dam at Troy, New York, and report a project and estimate of the cost of widening and deepening said river between New York City and the city of Albany, and also between New York City and the State dam at the city of Troy for the navigation of sea-going vessels drawing twenty feet of water, and also a separate estimate of the expense of improving the river between Coxsackie and the State dam at Troy, to such an extent as to secure a navigable channel twelve feet deep at mean low water. Said board shall accompany their report with a statement as to the usefulness of such improvements and of their relations and value to commerce, and of the advisability of entering upon the same at this time; and the Secretary of War shall transmit said reports to Congress with his own views and those of the Chief of Engineers, United States Army, thereon; and the expenses of said board shall be paid out of the appropriation made in this act for the improvement of the Hudson River, not to exceed ten thousand dollars.

The Board of Engineers, authorized and directed by the above law, completed the duty assigned it, and its report, dated October 1, 1891, which was concurred in by the Chief of Engineers and the Secretary of War, was transmitted to Congress and printed as House Ex. Doc. No. 23, Fifty-second Congress, first session. A copy is also herewith submitted, accompanying annual report of the officer in charge upon the improvement of Hudson River (Appendix E 1).

Three propositions looking to improvement of the navigation of the river were by the terms of the act to be considered by the Board and projects, with estimates of cost, required to be submitted.

(1) Between New York City and the city of Albany, for the navigation of seagoing vessels drawing 20 feet of water.

(2) Between New York City and the State dam at Troy, for the navigation of seagoing vessels drawing 20 feet of water.

(3) Between Coxsackie and the State dam at Troy, for navigable channel 12 feet deep at mean low water.

Upon these three several propositions the Board, after full and careful consideration, remarks as follows:

Concerning the first two—deep channels between New York City and Albany and between New York City and Troy—

> The Board is of the opinion that the possible benefits to commerce to be derived from the proposed improvement for vessels drawing 20 feet are not, under existing conditions, sufficient to justify at this time the expenditure necessary to make such improvement.
>
> * * * * * * *
>
> The estimates of cost of carrying out the two projects contained in the said act, which provide for widening and deepening the channels between New York City

and the city of Albany and between New York City and the city of Troy for the navigation of seagoing vessels drawing 20 feet of water, are $5,934,847.60 and $19,507,832.74, respectively.

Concerning the third—channel 12 feet deep between Coxsackie and the State dam at Troy—

> After carefully studying the wants of commerce, the Board is of the opinion that the third project contained in the act of September 19, 1890, which provides for improving the Hudson River "between Coxsackie and the State dam at Troy to such an extent as to secure a navigable channel 12 feet deep at mean low water," is a worthy and useful one, and accordingly recommends it for adoption.
>
> * * * * * * *
>
> In view of the necessities of the commerce incident to the river proper and its tributary country, the Board is of the opinion that the project for improvement adopted in 1867 should be extended so as to provide for a channel depth of at least 12 feet at mean low water, and that such an extension is well worth the expenditure required for its execution.

The estimate submitted by the Board for a channel 12 feet deep and 400 feet wide from Coxsackie to the foot of Broadway, Troy, and thence 12 feet deep and 300 feet wide to the State dam at Troy, is $2,447,906.56.

July 1, 1891, balance unexpended		$128,342.71
June 30, 1892, amount expended during fiscal year		87,228.98
July 1, 1892, balance unexpended		41,113.73
July 1, 1892, outstanding liabilities	$9,733.45	
July 1, 1892, amount covered by uncompleted contracts	11,246.75	
		20,980.20
July 1, 1892, balance available		20,133.53
Amount appropriated by act approved July 13, 1892		187,500.00
Amount available for fiscal year ending June 30, 1893		207,633.53
Amount (estimated) required for completion of existing project		2,260,406.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix E 1.)

2. *Harbor at Saugerties, New York.*—This harbor is formed by the mouth of Esopus Creek, which empties into the Hudson River, on the west bank, about 100 miles above New York City.

The bar at the entrance at the time of original examination, made in November, 1883, with the view of preparing estimates for improvement, had a navigable depth of 3 feet only at mean low water, and the distance between the 6-foot curves across it was 1,100 feet. The harbor could therefore be entered only at high water even by the smallest class of vessels. The range of tides is 4 feet, approximately.

The plan of improvement which was adopted in 1887 provided for securing a depth of 8 feet, mean low water, from the entrance to the head of navigation, 1¾ miles, by the construction of two parallel dikes, each 2,300 feet long, 260 feet apart on the inside and 280 feet apart on the outside, and by dredging, if found necessary, 30,000 cubic yards of material from the channel between the dikes.

The estimated cost of the improvement was $52,000; the amount expended upon the project up to the close of the fiscal year ending June 30, 1891, inclusive of outstanding liabilities, was $36,299.11. At that date the south dike had been completed, and its length was 2,363½ feet; the north dike had been completed for a length of 809 feet, and the shoal in front of Sheffield's paper mill had been dredged to afford a channel 50 feet wide and 7 to 8 feet deep, mean low water. The channel across the bar was 200 wide and 9 feet deep, mean low water, and work on the north dike extension was in progress.

The amount expended during the fiscal year ending June 30, 1892, inclusive of outstanding liabilities, was $7,085.30, and was applied toward the completion of 1,250 feet of pile dike on the north side of the creek.

The existing navigable depth from the entrance to the head of navigation is 9 feet, mean low water, in a channel from 100 to 300 feet wide.

July 1, 1891, balance unexpended	$7,678.24
June 30, 1892, amount expended during fiscal year	7,085.30
July 1, 1892, balance unexpended	592.94
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,592.94
Amount (estimated) required for completion of existing project	5,000.00
Submitted in compliance with the requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix E 2.)

3. *Harbor at Rondout, New York.*—This harbor is formed by the mouth of Rondout Creek, which empties into the Hudson River on its west side about 90 miles above the city of New York, and is the eastern terminus of the Delaware and Hudson Canal. The creek is a tidal stream for 3 miles above its mouth, and prior to 1871 all improvements had been made by private parties. The range of tides is 4 feet, approximately.

The Government made a survey of the harbor in 1869, and the available depth of water then in the channel was only 7 feet at mean low water. The project of improvement, based on this survey, was for the formation and maintenance of a channel 100 feet wide and 14 feet deep, mean low water, at the mouth of the creek, to be obtained by means of dikes and dredging. The parallel channel dikes, 350 feet apart at the entrance, were to be built outward into the Hudson River, and a branch dike upstream, starting at outer end of north pier, to protect the north dike against destruction by ice.

The estimated cost of the project was $172,500.

The project was completed in 1880 at an actual cost of $90,000 only. At that time the length of the north dike was 2,200 feet, and that of the south dike 2,800 feet, and there was a channel between them 50 feet wide and 13½ feet deep, mean low water, and 100 feet wide and 12 feet deep, mean low water.

The appropriations which have been made since 1880 have been applied exclusively to the repair of the dikes.

The amount expended upon the project and upon repairs up to the close of the fiscal year ending June 30, 1891, was $101,500, at which date the navigable channel was 100 feet wide and from 12½ to 13½ feet deep, mean low water. The dikes were built originally of timber and stone to the height of mean high water, but the timber has since become so damaged by age and by the ice that the stone filling in many places has fallen out between the rows of piles, and the height of the dikes has been correspondingly lowered.

The amount expended during the fiscal year ending June 30, 1892, inclusive of outstanding liabilities, was $5,000, and was applied in repairing the north and branch dikes by replacing worn and decayed timber and refilling with stone. The dikes are now in fair condition, except that the south dike requires some additional stone filling.

July 1, 1891, balance unexpended	$5,000.00
June 30, 1892, amount expended during fiscal year	5,000.00
Amount appropriated by act approved July 13, 1892	5,000.00
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	15,000.00

(See Appendix E 3.)

4. *Wappinger Creek, New York.*—Wappinger Creek is a small stream which empties into the Hudson River on left bank, one-half mile below the village of New Hamburg, N. Y. The navigable portion, extending from the mouth to Wappinger Falls, is 2 miles long approximately, and before improvement afforded navigation to small boats drawing not exceeding 6 feet in a water way which had a width varying from 25 feet to 75 feet. The range of tides at entrance is 4 feet approximately.

The project for its improvement contained in the report upon the survey November 11, 1889, to comply with the river and harbor act, August 11, 1888, contemplates a channel 80 feet wide and 8 feet deep from the mouth to the falls. The estimated cost of the improvement was $13,000. The amount appropriated by the river and harbor act of September 19, 1890, was $13,000.

The amount expended up to the close of the fiscal year ending June 30, 1891, inclusive of outstanding liabilities, was $80.33.

The amount expended during the fiscal year ending June 30, 1892, inclusive of outstanding liabilities, was $12,756.82.

The project was completed April 30, 1892.

There is now a navigable channel from the entrance to the Falls with a least width of 80 feet and a least depth of 8 feet, mean low water.

July 1, 1891, balance unexpended	$12,919.67
June 30, 1892, amount unexpended during fiscal year	12,756.82
July 1, 1892, balance unexpended	162.85

(See Appendix E 4.)

5. *Harlem River, New York.*—The Harlem River and Spuyten Duyvil Creek are both included in this improvement.

Originally there was no navigable water way between the two streams, as the bed of the connecting reach at Kingsbridge was a long reef of solid rock, bare at low water. The head of navigation at low tide in the Harlem River was practically at High Bridge, 5 miles from its junction with the East River at Hell Gate, for vessels of 7 feet draft, and, at high tide, in Spuyten Duyvil Creek, near Kingsbridge, 1¾ miles from the Hudson, for vessels of 8 feet draft.

The object of the improvement is to form a navigable channel between the East and Hudson rivers.

The project for the improvement as originally adopted in 1875 was for a channel 350 feet wide and 15 feet deep at mean low water. In 1879 the project was so far modified as to increase the width of the channel in the Harlem River and Spuyten Duyvil Creek to 400 feet, retaining the original width of 350 feet through Dyckman Meadow, but increasing the depth there to 18 feet, mean low water. This project was revised in 1886 by narrowing the channel immediately north of High Bridge, where it skirts the Ogden estate on the east bank, to a least width of 375 feet.

The estimated cost of the work was $2,700,000; the amount expended upon the improvement up to the close of the fiscal year ending June 30, 1891, inclusive of outstanding liabilities, was $448,696.28. At that date the excavation of the section of canal prism lying to the west of old Kingsbridge road had been carried down to grade over an area of 203,575 square feet, completing the section of cut to be excavated under the contract of December 15, 1887, with the exception of a core of rock left standing in the center of the excavation for temporary use as a roadway, and a spur of rock in the southwest end over which the tramway for transporting the broken stone to the dumping ground passed. Both these ledges covered an area of 42,000 square feet, and were in process of removal. The old Kingsbridge road, where it crossed the canal, had been closed, and the material composing it excavated down to the underlying rock surface, and a temporary roadway over the east dam had been opened to public traffic. The earth, turf, and meadow sod between the east dam and the westerly limit of the contract of August 12, 1889, had been nearly all excavated down to grade, and the rock excavation begun and grade reached over an area of 600 square feet.

Nearly all the rock to be removed under the contract of March 9, 1891, had been stripped of earth, and the excavation in the rock had been carried down to grade over an area of 1,400 square feet. The dredging in the Harlem River began near Fordham footbridge, and had been carried northward toward Kingsbridge in a water way 600 feet long, 75 to 150 feet wide, and 9 feet deep at mean low water. The contract for work west of west dam was not begun.

The amount expended during the fiscal year ending June 30, 1892, inclusive of outstanding liabilities, was $190,421.14. At that date the excavation of the section of canal prism lying between the two dams had been carried down to grade over an area of 285,000 square feet, leaving an area of only 65,000 square feet, over which the rock remains to be excavated in order to complete the cut between the dams, and a large portion of this rock had already been reduced to within a few feet of grade. A total of 625 linear feet of stone revetment wall, and 190 linear feet of timber revetment had been built to protect the side slopes of the canal chamber where necessary, to prevent the loose rock and earth arising from degradation of the slopes from falling into the cut after the canal has been opened to navigation. In the Harlem River a channel 9 feet deep, mean low water, and about 150 feet wide had been dredged from a point 900 feet north of Fordham footbridge, where it connects with the natural channel, to within 200 feet of the east dam. In Spuyten Duyvil Creek the channel near the Hudson River railroad drawbridge had been widened to about 65 feet, with a depth of 8 feet, mean low water, the channel over the bar at the rolling mill deepened to 8 feet, mean low water, the point of meadow opposite the Government dock cut off so as to widen the channel at this point to 240 feet, and Dyckman Creek and the meadow in front of the west dam had been excavated to nearly the full projected width and depth to within 100 feet of the west dam.

July 1, 1891, balance unexpended		$342,298.95
June 30, 1892, amount expended during fiscal year		152,161.66
July 1, 1892, balance unexpended		190,137.29
July 1, 1892, outstanding liabilities	$38,259.48	
July 1, 1892, amount covered by uncompleted contracts	142,204.41	
		180,463.89
July 1, 1892, balance available		9,673.40
Amount appropriated by act approved July 13, 1892		175,000.00
Amount available for fiscal year ending June 30, 1893		184,673.40

Amount (estimated) required for completion of existing project.....$1,805,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix E 5.)

6. *East River and Hell Gate, New York.*—Originally the channel of East River contained many dangerous rocky obstructions to navigation, lying both above and below mean low water. Especially was this the case at Hell Gate, where the bounding beaches had irregular and shoal rocky foreshores, and the inclosed water way had a few detached rocky isles with crests rising several feet above high-water mark.

At Hell Gate the channel turns at right angles around Hallets Point, Astoria, and the current runs with a velocity varying at different stages of the tide from 3 to 10 miles an hour over or around Way Reef, Pot Rock, Shell Drake, Frying Pan, Hallets Point, Negro Point, Holmes Rock, Hog Back, Heel Tap, Flood Rock, Hen and Chickens, Gridiron, Mill Rocks, The Negro Heads, Rhinelander Reef, and Bread and Cheese.

Hallets Point projected from the shore at Astoria under water 325 feet to the 26-foot contour, mean low water, and embraced an area of 3 acres.

The detached rocks in the inclosed water way had varying depths over them. The Middle Reef, with an area of about 9 acres, lay in the middle of the channels of Hell Gate. It had a small backbone, projecting above high water, called Flood Rock, upon which vessels were frequently stranded at ebb tide when the currents swept directly over the rock. To the northward, near the mouth of the Harlem River, lay the two Mill Rocks, both of which were usually visible at high water. To the eastward Frying Pan had only 11 feet, mean low water; Heel Tap, 12 feet; Pot Rock, 20 feet, and North Brother Island Reef, 16 feet.

The project of improvement adopted in 1867 provided for the removal to the depth of 26 feet, mean low water, of the rocks and reefs that lay directly in the channel at Hell Gate, and for the construction of sea walls and dikes upon others that lay near the edge of the channel. The estimated cost of the project, revised in 1870, was $4,689,820.

Besides the obstructions before enumerated submerged rocks were known to exist at other points in the channel, such as Diamond Reef, 16½ feet, mean low water, off the Battery; Coenties Reef, 14.3 feet, mean low water, off Coenties Slip; Shell Reef, 9 feet, mean low water, between Eighth and Tenth streets; Ferry Reef, 7 feet, mean low water, and Charlotte Rock, 14½ feet, mean low water, opposite Thirty-fourth street; the Middle Ground, 11½ feet, mean low water, off Sunken Meadow, at the entrance to Little Hell Gate, and Mid-Channel Reef, 16½ feet, mean low water, at Baretto Point, opposite Rikers Island.

The project was enlarged in 1874, and the total cost estimated at $5,139,120 (Annual Report, Chief of Engineers, 1874, Part II, page 164). Besides the improvements already projected at Hell Gate, the new project provided for the construction of a riprap dike to connect the Mill Rocks; sea walls upon Hog Back and Holmes Rock, and the removal to a depth of 26 feet, mean low water, of Diamond Reef, Coenties Reef, and the small rocks known as Scaly Rock, Blackwells Rock, and the Rock off Woolsey's bath house.

The project was enlarged in 1884 to provide for the removal of Pilgrim Rock, opposite Nineteenth street, to 24 feet, mean low water; again in 1889 for the removal of reef off Diamond Reef to 26 feet, mean low water, and Ferry and Charlotte Rocks opposite Thirty-fourth street, to 26 feet mean low water, and again in 1890 for the removal of Shell Reef and Middle Ground to 18 feet, mean low water.

The amount expended up to the close of the fiscal year ending June 30, 1891, inclusive of outstanding liabilities, was $3,905,139.09. At that date Hallets Point, covering 3 acres, Way Reef, Shell Drake, Diamond Reef, North Brother Island Reef, Coenties Reef, and Scaly Rock had been removed to the depth contemplated in the project. Pilgrim Rock had been reduced to a least depth of 24 feet; Heel Tap had been broken to 26 feet and dredged to 20.5 feet, and the least depths on Frying Pan and Pot Rock were 18 feet and 22.8 feet at mean low water, respectively; Ferry Reef, off Thirty-fourth street, had been lowered from a least depth of 7.1 feet to a least depth of 19 feet, and 4,480 tons of rock had been removed from reef off Diamond Reef. Flood Rock and connecting reefs, covering 9 acres, had been broken to 30 feet, and 156,504 tons of débris had been removed; the Negro Heads and Hen and Chickens and been reduced to 18 feet, mean low water, and a new 18-foot channel, 500 feet wide, had been opened across the reef. Sea walls had been built by the Government to connect Great and Little Mill Rocks, and by the city authorities on Bread and Cheese. Under contract, 3,435½ cubic yards of material and 960½ tons of bowlders had been removed from Shell Reef, off Ninth street. These results have been of the greatest value to navigation.

The amount expended during the fiscal year ending June 30, 1892, inclusive of outstanding liabilities, was $160,546.81, and was applied in removing, by hired labor, 20,872 tons of broken stone from Flood Rock, by the use of the two United States engineer dredges; in removing 1,211.2 tons of rock by use of the United States steam-drill scow from reef off Diamond Reef, completing its removal to the contemplated depth of 26 feet, mean low water; in removing 1,763 tons of rock, by use of the United States steam-drill scow and the United States engineer dredge *Hell Gate* from Ferry Reef, off Thirty-fourth street, reducing the least depth over it to 24 feet, mean low water; in removing, by use of the United States engineer dredge *Hell Gate* 158 tons of large bowlders from upper end of Shell Reef, and in removing under contract 52,803½ cubic yards of fine material and 2,507½ tons of bowlders from Shell Reef, off Ninth street, and 392 cubic yards of small broken stone and 323 tons of bowlders from Middle Ground opposite Sunken Meadow.

July 1, 1891, balance unexpended		$203, 577. 89
June 30, 1892, amount expended during fiscal year		137, 651. 48
July 1, 1892, balance unexpended		65, 926. 41
July 1, 1892, outstanding liabilities	$22, 895. 33	
July 1, 1892, amount covered by uncompleted contracts	1, 357. 54	
		24, 252. 87
July 1, 1892, balance available		41, 673. 54
nount appropriated by act approved July 13, 1892		150, 000. 00
nount available for fiscal year ending June 30, 1893		191, 673. 54
Amount (estimated) required for completion of existing project		888, 840. 67

ubmitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

See Appendix E 6.)

Newtown Creek, New York.—This is a tidal stream, about 4 miles g, running through the eastern part of Brooklyn, and emptying into East River opposite Thirty-fourth street, New York City.

It had formerly a depth of 12½ feet, mean low water, at the mouth, gradually decreasing to 4 feet at the head.

The original project for improvement, adopted in 1880, but modified in 1883, provided for a channel 200 feet wide and 21 to 22 feet deep, mean low water, extending from the mouth up to Vernon Avenue Bridge, and from that point up to the head of navigation on both branches, a channel decreasing from 175 feet to 100 feet in width, and from 18 feet to 10 feet in depth, at an estimated cost of $255,569.

The amount expended up to the close of the fiscal year ending June 30, 1891, inclusive of outstanding liabilities, was $136,026.07. At that date the channel from the entrance to Vernon avenue bridge was 175 feet wide at the entrance and 150 feet wide near the bridge, and 21 feet deep. The channel from Vernon Avenue Bridge to Central Oil Works was 80 feet wide and 18 feet deep; from Central Oil Works to Queens County Oil Works, 25 feet wide and 15 feet deep; from Queens County Oil Works to Penny Bridge, 25 feet wide and 12 feet deep. The channel from Maspeth avenue to Metropolitan avenue was 100 feet wide and 10 feet deep, mean low water. In the English Kills branch the channel was 100 feet wide and 10 feet deep from Nichols's Chemical Works to a point 700 feet to the eastward.

The amount expended during the fiscal year ending June 30, 1892, inclusive of outstanding liabilities, was $12,554.08, and was applied in dredging 15,648 cubic yards of material in the reach from Central Oil Works to Penny Bridge, to gain depths varying from 12 to 15 feet, mean low water. A survey made in April, 1892, shows that the depths in the various reaches have materially decreased by shoaling since work was suspended. At that date the channel from the entrance to Vernon Avenue Bridge was 175 feet wide and 18 feet deep, mean low water; the channel from Vernon Avenue Bridge to Central Oil Works was 80 feet wide and 16 feet deep; from Central Oil Works to Queens County Oil Works, 50 feet wide and 14 feet deep, and from Queens County Oil Works to Penny Bridge, 50 feet wide and 10 feet deep. The channel from Maspeth avenue to Metropolitan avenue is 100 feet wide and 9 feet deep, mean low water. In the English Kills branch the channel is 100 feet wide and 8 feet deep from Nichols's Chemical Works to a point 700 feet to the eastward.

The cause of the habitual shoalings immediately following dredging is the absence of bulkheads to confine the banks.

The existing channel is not adequate in width or depth to the demands of commerce, and the adopted project for improvement should be completed as early as practicable by methods which will carry the improvement progressively from the mouth to the head of navigation.

July 1, 1891, balance unexpended	$13,605.94
June 30, 1892, amount expended during fiscal year	12,554.08
July 1, 1892, balance unexpended	1,051.86
Amount appropriated by act approved July 13, 1892	35,000.00
Amount available for fiscal year ending June 30, 1893	36,051.86
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	78,000.00

(See Appendix E 7.)

8. *Buttermilk Channel, New York Harbor.*—Buttermilk Channel lies between the city of Brooklyn, N. Y., and Governors Island, New York Harbor, and was formerly obstructed at its upper end, where it joins the East River, by a shoal, over which there was a least depth of 9½

feet at mean low water. The crest of this shoal lay about 800 feet distant from the line of the Brooklyn wharves.

The original project of improvement, adopted in 1881, provided for the removal to a depth of 26 feet, mean low water, of such parts of the shoal as came within 850 feet of the Brooklyn wharves, which would take off the crest of the shoal and give elsewhere a depth of not less than 15 feet, mean low water.

The estimated cost of the improvement was $210,000. In view of the increasing importance of the wharves on the Brooklyn shores and the difficulty experienced by deep-draft vessels in getting up to them by reason of this shoal, the project of improvement was modified in 1885 so as to provide for the removal of the entire shoal to a depth of 26 feet, mean low water, at an estimated additional cost of $150,000, making the total estimated cost of the project $360,000.

The amount expended to the close of the fiscal year ending June 30, 1891, inclusive of outstanding liabilities, was $321,926.56, and was applied in dredging. The shoal had been entirely removed to a depth of 26 feet, mean low water.

The amount expended during the fiscal year ending June 30, 1892, inclusive of outstanding liabilities, was $12,051.98, and was applied to payment of liabilities outstanding at the beginning of the fiscal year.

There is a balance of $24,843.25 remaining from the appropriation of September 19, 1890, available for application toward the further improvement of Buttermilk Channel by excavation from the shoal opposite Red Hook Point. This balance and the appropriation of $100,000 made by the river and harbor act of July 13, 1892, will be applied in widening and deepening the existing channel at the southern entrance as far as the funds available will permit. The improved depth will be 26 feet at mean low water.

July 1, 1891, balance unexpended	$36,895.23
June 30, 1892, amount expended during fiscal year	12,051.98
July 1, 1892, balance unexpended	24,843.25
Amount appropriated by act approved July 13, 1892	100,000.00
Amount available for fiscal year ending June 30, 1893	124,843.25
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	429,000.00

(See Appendix E 8.)

9. Gowanus Bay, New York—Red Hook, Gowanus Creek and Bay Ridge channels.—Gowanus Bay is a part of New York Harbor, lying at the mouth of Gowanus Creek, in the southwestern part of the city of Brooklyn.

The depth of water in the channel of Gowanus Creek and Bay was originally only from 7 to 12 feet at mean low water, which was wholly insufficient for the passage of vessels employed in the commerce of the district.

The plan of improvement, adopted in 1881, provided for a depth of 18 feet to the channels in the bay leading up to the mouth of the creek on both the north and south sides, and for carrying the improvement with the same depth up the creek to Hamilton Avenue Bridge, a distance of 1 mile.

The channel's widths were to be 200 feet, except for the last few hundred feet up to the bridge, in which distance the width would gradually decrease.

The estimated cost of this improvement was $192,564.90.

The project of 1881 was modified in 1888 by increasing the depth to 21 feet and the width to 400 feet, while to facilitate the handling of vessels in the contracted space near the mouth of Gowanus Creek more room was provided for by cutting away the angle on the south side at an estimated total cost of $600,000.

The amount expended on the *Red Hook and Gowanus Creek channels* up to June 30, 1891, inclusive of outstanding liabilities, was $155,004.99. At that date this channel, from the entrance to Erie Basin to Twenty-eighth street, was 150 feet wide and 21 feet deep, mean low water; thence to the foot of Percival street, 100 feet wide and 21 feet deep, and the triangular slips at the foot of Court, Bryant, and Smith streets, had been dredged to 21 feet.

The improvement of *Bay Ridge channel*, extending from Twenty-eighth street south and west to Sixtieth street, south shore, which, under the project of 1881 was suspended in 1884, was resumed in May, 1891, under a specific appropriation of $100,000 contained in the river and harbor act of September 19, 1890, which provided for a channel 400 feet wide and 21 feet deep. Up to June 30, 1891, the sum of $18,450.15, inclusive of outstanding liabilities, had been expended under contract. At that date the improved channel, beginning at Forty-second street, had been carried north a distance of 1,800 feet, 30 feet wide and 21 feet deep, and south a distance of 650 feet, 35 feet wide and 21 feet deep.

The amount expended during the fiscal year ending June 30, 1892, on the *Red Hook and Gowanus Creek channels*, inclusive of outstanding liabilities, was $39,081.95, and was applied in removing 154,918 cubic yards of material under contract. When work was suspended, on exhaustion of appropriation, May 17, 1892, this channel, from the entrance to Erie Basin to Twenty-eighth street, was 230 feet wide and 21 feet deep, mean low water, and thence to the foot of Twenty-third street, 150 feet wide and 21 feet deep, mean low water.

The amount expended on the *Bay Ridge Channel* during the fiscal year ending June 30, 1892, inclusive of outstanding liabilities, was $95,833.35, and was applied in removing 365,025 cubic yards of material under contract. When work was suspended on exhaustion of appropriation, June 18, 1892, this channel was 120 feet wide and 21 feet deep, mean low water, from Twenty-eighth street south to Thirty-ninth street; thence 90 feet wide and 21 feet deep to Sixtieth street, opposite Bay Ridge.

The beds of both channels have been lowered from 5 to 15 feet, and as the material removed has been sand, the banks, having no confining bulkheads, have correspondingly increased their slopes, causing the unstable material to slide into the channels and reduce their depths.

The channels also suffer from deposits carried down from Gowanus Canal, and from deposits brought in from outlying shoals by the waves.

These sources of degradation will be appreciably exhausted only when permanent bulkheads are built along both shores to hold the soft and unstable banks.

July 1, 1891, balance unexpended	$136,058.10
June 30, 1892, amount expended during fiscal year	106,878.53
July 1, 1892, balance unexpended	29,179.57
July 1, 1892, outstanding liabilities	28,036.77
July 1, 1892, balance available	1,142.80
Amount appropriated by act approved July 13, 1892	198,600.00
Amount available for fiscal year ending June 30, 1893	199,742.80

Amount (estimated) required for completion of existing project...... $281,400.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix E 9.)

10. New York Harbor, New York.—Before the improvement of the main entrance into New York Harbor was undertaken by the United States, the least depth in mid-channel on the bar was 23.7 feet at mean low water, and the same was the limiting depth across three other shoals between the bar and deep water in the harbor.

A large proportion of the vast commerce of the port which is carried on in vessels of great draft could only cross these shoals at or near high water.

The project for the improvement of Gedney Channel was approved by the Secretary of War in December, 1884, and its extension to cover the whole of the main entrance to the harbor received his approval December 27, 1886. It provides for dredging a channel 1,000 feet wide and 30 feet deep at mean low water, from deep water below the Narrows through the Main Ship Channel and Gedney Channel to deep water outside the bar; maintaining this channel, should it be necessary, either by periodical dredging or by contracting the entrance by the construction of a dike running across the shoals from the Coney Island side, with suitable protection for the head of Sandy Hook to prevent its being scoured away by the increased current.

The estimated cost of obtaining the dredged channel was $1,490,000 for dredging 4,300,000 cubic yards, and the entire cost of the improvement should the contraction works prove to be necessary was estimated at between $5,000,000 and $6,000,000.

Under this project an extended survey of the lower bay was made, on which the method of improvement was based.

The total amount expended to June 30, 1891, inclusive of outstanding liabilities, was $1,406,188.89.

At that time Gedney Channel and Bayside Channel (east and west) were practically completed, having a depth of 30 feet, mean low water, for the full projected width of 1,000 feet.

The Main Ship Channel from Buoy No. 10 north to Buoy No. 12 had then a depth of 30 feet, mean low water, for a width varying from 500 to 800 feet, and a depth of 28 feet for a width of 1,000 feet throughout. From Buoy No. 12 northward to deep water below the Narrows there was then a 30-foot channel not previously improved, 400 feet wide, and a 28-foot 1,000 feet wide. The 30-foot channel had a least width of 400 feet from deep water below Buoy No. 10, Lower Bay, to deep water below the Narrows, a distance of 22,000 feet, and there was a 28-foot channel, 1,000 feet wide, throughout the entire length of this reach.

The riprap sea wall authorized by the Chief of Engineers February 20, 1890, for the protection of the north shore of Sandy Hook was built from a point 375 feet east of Jetty No. 4, westward to a point 200 feet west of Jetty No. 10, a total distance of 2,375 feet.

The amount expended during the fiscal year ending June 30, 1892, nclusive of outstanding liabilities, was $95,375.95. The contract with The Joseph Edwards Dredging Company, dated February 16, 1891, for he removal of 500,000 cubic yards of material was completed October 10, 1891. During the fiscal year there was removed 213,268 cubic yards rom the Main Ship Channel from Buoy No. 12 (Southwest Spit) northward to deep water below the Narrows, nearly opposite Buoy No. 11, nd the channel at the time work was suspended, October 10, 1891, ad a width of 1,000 feet and a depth of 30 feet, mean low water, from deep water below the Narrows to deep water beyond the bar. Detailed surveys of all the improved channels were made during November and December, 1891, and January, 1892, and the results showed that the improved depths have been maintained without appreciable deterioration.

Baxter Ledge, a narrow ledge of rock lying in the entrance to Kill van Kull from Upper New York Bay, northeast from St. George, Staten Island, and having over it originally a least depth of 18 feet, mean low water, was successfully removed to 25.5 feet, mean low water, using the United States plant connected with the East River and Hell Gate improvement.

Under the contract with John Satterlee, dated March 26, 1891, 3,110 tons of large stone were delivered and placed in position in the riprap sea wall for the protection of the north shore of Sandy Hook. This wall is now 2,575 feet long, extending from Jetty No. 1 westward to a point 119 feet westward of Jetty No. 11.

July 1, 1891, balance unexpended	$120,116.57
June 30, 1892, amount expended during fiscal year	93,572.22
July 1, 1892, balance unexpended	26,544.35
July 1, 1892, outstanding liabilities	1,803.73
July 1, 1892, balance available	24,740.62
Amount appropriated by act approved July 13, 1892	170,000.00
Amount available for fiscal year ending June 30, 1893	194,740.62

(See Appendix E 10.)

11. Raritan Bay, New Jersey.—Raritan Bay forms the western part of the large triangular bay inclosed between Sandy Hook, the New Jersey shore, and Staten Island.

The channel undergoing improvement lies to the southeast of Seguine Point on the south shore of Staten Island. At the time of the original survey, August, 1880, the least depth on the shoal lying between the 21-foot curve at Seguine Point and the 21-foot curve at the head of the bay was 14½ feet, mean low water. The project of improvement, based upon the survey, provided for a channel across the shoal 300 feet wide and 21 feet deep, mean low water, at an estimated cost of $126,500.

The project was enlarged in 1885, providing for a channel of equal width and depth over the shoals in the vicinity of Ward Point, Staten Island, where the original depth was 18 feet, mean low water, giving a navigable channel 21 feet deep, mean low water, up to Perth Amboy; and further providing for a channel 300 feet wide and 15 feet deep, mean low water, from Great Beds Light to South Amboy, where the original depth was 12½ feet, mean low water, at an estimated total cost of $240,500, for the two works from the beginning, which estimate was again increased in 1888 to $246,500, to provide for the removal of deposits which had taken place in the interval of three years.

The channel from deep water at the head of Raritan Bay past Seguine Point to Perth Amboy exceeds 5 miles in length, is crooked, and is subject to constant shoalings. As the amount appropriated any one year for the execution of the project has been much less than the estimated cost of the improvement, and as the channel excavated under each appropriation has been impaired by shoaling in a greater or less degree before work could be resumed under the succeeding appropriations, the original estimates for this improvement have little value and can not be used for determining the amount required for completing the project at this date. The cost of completing the project, if all the required money could be made available at one time, was estimated in 1891 at $175,375.

The amount expended upon the modified project of 1885 up to the close of the fiscal year ending June 30, 1891, inclusive of outstanding liabilities, was $197,680.02. At the close of the contract, June 15, 1888, the channel was 300 feet wide and 21 feet deep, mean low water, from Perth Amboy to the bend at Great Beds Light, and 300 feet wide and 20 feet deep, mean low water, across the crest of the shoal in the channel leading from the bend toward Seguine Point. At the close of the year the channel eastward of Seguine Point was 100 feet wide, with a depth of 21 feet, mean low water, and the channel from Great Beds Light to South Amboy was 170 feet wide and 15 feet deep, mean low water.

The amount expended during the fiscal year ending June 30, 1892, inclusive of outstanding liabilities, was $30,827.09, and was applied in dredging 8,095 cubic yards of material from the channel leading from Great Beds Light to South Amboy, N. J., and 106,195 cubic yards of material from the Seguine Point Channel.

When work was suspended on exhaustion of appropriation, September 24, 1891, the channel leading eastward from Seguine Point was 180 feet wide and 21 feet deep, mean low water, and the channel from Great Beds Light to South Amboy was 170 feet wide and 15 feet deep, mean low water.

July 1, 1891, balance unexpended	$32,050.24
June 30, 1892, amount expended during fiscal year	30,754.28
July 1, 1892, balance unexpended	1,295.96
July 1, 1892, outstanding liabilities	72.81
July 1, 1892, balance available	1,223.15
Amount appropriated by act approved July 13, 1892	40,000.00
Amount available for fiscal year ending June 30, 1893	41,223.15
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	95,375.00

(See Appendix E 11.)

12. *Removing sunken vessels or craft obstructing or endangering navigation.*—The wreck of an old canal boat was removed from Gravesend Bay, Lower New York Harbor, August 12, 1891, under contract with Mr. John F. Baxter, at a cost of $144.

The wreck of a canal boat was removed from Raritan Bay, near South Amboy, N. J., February 1, 1892, under contract with the Chapman Derrick and Wrecking Company, at a cost of $199.

(See Appendix E 12.)

EXAMINATION AND SURVEY, MADE IN COMPLIANCE WITH PROVISIONS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination *for canal from main channel from Jamaica Bay easterly to Long Beach Inlet, New York*, was made by the local engineer in charge, Lieut. Col. Gillespie, and report thereon submitted. It is his opinion, based upon the facts and reasons given, that only the western portion of the water way mentioned in the act is worthy of improvement. This opinion being concurred in by me, Lieut. Col. Gillespie was charged with and has completed survey of this portion of the water way (being the eastern part of Jamaica Bay) and submitted report thereon.

The improvement proposed contemplates the excavation of a navigable water way, 60 feet wide and 5 feet deep at mean low water, from Beach Channel to some point on the eastern shore of Jamaica Bay. Three routes, with estimates, are submitted, as follows:

1. From Beach Channel, through Conch Hole, to Citizens Cut, at Far Rockaway	$21,406
2. From Beach Channel, through Bass Channel, to Citizens Cut, at Far Rockaway	18,920
3. From Beach Channel, through Bass Channel, to eastern shore of Jamaica Bay, near foot of Bayswater avenue	9,460

In connection with the Conch Hole route, Lieut. Col. Gillespie states:

> If an appropriation be made for making an artificial water way through the eastern part of Jamaica Bay along the Conch Hole route, the act should provide that the money shall not become available until after the right of way over such parts as lie above high water shall have been ceded to the Government free of charge.

The reports were transmitted to Congress and printed as House Ex. Doc. No. 29, Fifty-second Congress, first session. (See also Appendix E 13.)

IMPROVEMENT OF RIVERS AND HARBORS ON SOUTHWESTERN SHORE OF LONG ISLAND AND NEAR STATEN ISLAND, NEW YORK, AND IN NORTHEASTERN NEW JERSEY.

Officer in charge, Capt. Thomas L. Casey, Corps of Engineers; division engineer, Col. Henry L. Abbot, Corps of Engineers.

1. *Sumpawanus Inlet, New York.*—The channel depth at the time of the adoption of the project varied from 5 feet in the bay at mean low water to 2 feet at the wharf at the mouth of the creek, a distance of a little over half a mile.

The project for the improvement of this inlet, known locally as Sumpawams Creek, adopted in 1880, provided for dredging a channel about 4,500 feet long and from 100 to 150 feet wide and 5 feet deep at mean low water, beginning at the 5-foot curve in the Great South Bay and extending up to the town of Babylon, Long Island.

The amount expended under this project to June 30, 1891, was $7,000.

With this amount a channel 75 feet wide and 5 feet deep from the steamboat wharf to a point 750 feet below it was dredged, besides dredging two cuts, each 25 feet wide, alongside the wharf.

Outside of the cuts so made and extending to the 5-foot curve in the bay a shoal was left, on which the depth was only 4¾ feet.

An examination made in 1886 showed that since the last dredging was done, in 1883, both the cut and the flat outside had shoaled from 6 inches to 1 foot, the depth in the cut being about 5 feet, while on the flat it was from 4 to 4½ feet. The 5-foot curve in the bay was about 1,500 feet from the steamboat wharf, but inside this curve, for about 750 feet towards the wharf, lay the flat.

The commerce of the inlet is reported for the calendar year 1891 to be 1,427 tons, against 1,278 tons for 1890. The passenger traffic to Fire Island Beach during the past year is stated to be in excess of that reported for 1890, viz, 10,000.

There were no expenditures on account of this work during the fiscal year ending June 30, 1892, there being no funds available.

Amount (estimated) required for completion of existing project $16,115.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix F 1.)

2. *Canarsie Bay, New York.*—The original condition of the channel leading to Canarsie answered to a depth of 4½ feet, mean low water.

The original project, adopted in 1879, provides for obtaining a navigable channel 6 feet deep at mean low water from Canarsie Landing to the deep water in Jamaica Bay by means of diking and the formation of a tidal basin. In the Annual Report of the Chief of Engineers, 1880, Part I, page 574, Gen. Newton expressed a doubt as to adequate appropriations being made for carrying out the authorized project and suggested that dredging be tried as an expedient.

The amount expended to the close of the fiscal year ending June 30, 1891, was $42,688.36.

With this amount two pile dikes have been built, one on the north side of the outer end of the channel, the other on the south side, their lengths being 1,058 feet and 820 feet, respectively; the channel dredged to a depth of 6 feet, mean low water, and width of from 50 to 125 feet from Canarsie Landing to deep water in Jamaica Bay, besides several minor improvements not contemplated in the original project.

The expenditures during the fiscal year ending June 30, 1892, amount to $5,255.77.

With this amount the channel was increased in width by 50 feet for a distance of 1,950 feet from the landing at Canarsie, one cut being dredged from each side; two cuts were also taken from the south side of the channel, extending for a distance of 600 feet from the outer end of the north dike, and a single cut 180 feet in length along the side of the dock at Canarsie Landing, and necessary repairs were made to the north dike. The main channel has now a width of 100 to 150 feet, with a minimum depth of 6 feet, mean low water, from Canarsie Landing to the deep water in Jamaica Bay.

The commerce of Canarsie Bay is reported for the calendar year 1891 to be 56,210 tons, against 50,898 tons reported for 1890.

July 1, 1891, balance unexpended	$5,311.64
June 30, 1892, amount expended during fiscal year	5,255.77
July 1, 1892, balance unexpended	55.87
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,055.87
Amount (estimated) required for completion of existing project	35,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix F 2.)

3. *Sheepshead Bay, New York.*—The original condition of the navigable channel was, for the entrance, a depth of a little over 2 feet at mean low water, and for the interior channel not less than 4 feet, except at two narrow bulkheads across said channel.

The originally adopted project (1879) was to deepen the entrance by means of converging jetties and to improve the interior channel by longitudinal dikes, so placed as in some instances to form tidal reservoirs for the scour of the channel. The project was revised in 1881 and provides for excavating a channel at the outlet 100 feet wide and 6 feet deep at mean low water, to connect the bay with Dead Horse Inlet, and to dredge the interior channel; this was modified in February, 1889, the modified project contemplating a channel 5,350 feet long, 60 feet wide, and 5½ feet deep, mean low water, from the town of Sheepshead to within 1,080 feet of Dead Horse Inlet Cut, to connect with the channel of similar width and depth already existing at that point.

The amount expended on this project to the end of the fiscal year ending June 30, 1891, was $25,784.26.

With this amount a channel had been dredged 100 feet wide and 6 feet deep at mean low water, connecting the east end of the bay with Dead Horse Inlet, and the interior channel dredged 60 feet wide and 5½ feet deep at mean low water, for a distance of 3,400 feet, from the town of Sheepshead toward Dead Horse Inlet. The first-mentioned channel, from a survey in 1887, was observed to have not maintained itself, having contracted to a width of 60 feet with an average depth of 5½ feet, mean low water; the condition of the more recently dredged interior channel, however, has been found by an examination, made in 1891, to be highly satisfactory.

July 1, 1891, balance unexpended	$215.74
June 30, 1892, amount expended during fiscal year	43.17
July 1, 1892, balance unexpended	172.57
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	8,200.00

(See Appendix F 3.)

4. *Arthur Kill, New York and New Jersey.*—A history of this improvement, which originated by special resolution of the Committee of Commerce in the Senate, is given in the Annual Report of the Chief of Engineers, 1889, Part I, page 819.

The improvement consists in the removal of a point of land near and to the south of the Staten Island Bridge, for the purpose of straightening the channel, in order that the currents may be directed more truly in a direction perpendicular to the draw span of the bridge, thus facilitating the passage of long tows.

A statement of condemnation proceedings for acquiring to the United States the land needed for this improvement will be found in the Annual Report of the Chief of Engineers for 1890, Part I, page 843.

The total amount expended on this improvement to June 30, 1891, was $10,340.59; with this amount payments had been made in the condemnation proceedings alluded to above, in the part purchase of the Government tug at present on the Raritan River, and in dredging off about one-half an acre of the obstruction known as "Steep Point," with a resulting increase of 150 feet in the channel width and with a uniform depth of 13 feet at mean low water where the land was originally 6 feet above that plane.

The available funds appropriated by the act of September 19, 1890, were covered by a contract made with the Atlantic Dredging Company on March 21, 1891, which was completed June 25, 1891, as stated in my last annual report. This work resulted in an additional channel width of 60 feet, with the same mean low-water depth as stated in the preceding paragraph, and another half acre of land was removed, making a total of about one acre removed under the project and giving a total channel width at this point of 710 feet. No work has been done during the fiscal year.

The commerce was reported for the calendar year 1890 to be 6,945,604 tons, against 6,947,635 tons for 1891.

July 1, 1891, balance unexpended	$6,659.41
June 30, 1892, amount expended during fiscal year	5,905.00
July 1, 1892, balance unexpended	754.41
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,754.41

Amount (estimated) required for completion of existing project	$4,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix F 4.)

5. *Channel between Staten Island and New Jersey.*—Before this improvement was undertaken by the United States there was a navigable channel having a minimum depth of 9.2 feet from the deep water in Newark Bay to Elizabethport.

The first project for the improvement of this channel was made in 1873. This provided for dredging it to a depth of 16 feet for a width of 150 feet at its shallowest part, and protecting the cut by parallel dikes. The estimated cost of this was $443,210.

This project was changed in 1880 so as to dredge a channel 400 feet wide and 13 feet deep over the middle 200 feet of its width, leaving it but 12 feet deep over the remaining widths of 100 feet on each side. The estimated cost of this work was $125,705. In addition to this it was proposed, should it be found necessary, to build four detached dikes along the line of the channel, two on the north and two on the south side, the estimated cost of which was $60,000, bringing the total estimated cost of the proposed improvement up to $185,705. Subsequently it was decided to give the channel 13 feet depth for its full width of 400 feet, increasing the estimate to $210,000.

A modification of this project, having in view the abandonment of the dikes, was submitted May 9, 1889, and was approved by Department letter dated May 15, and a further modification, calling for a uniform channel depth of 14 feet at mean low water over the entire width of 400 feet, was approved October 20, 1890.

The amount expended to June 30, 1891, was $190,611.06.

With this amount 2,237 feet of dike was built, the channel dredged throughout its entire projected length to a mean low-water depth of 13 feet, with widths varying from 300 to 350 feet, and in the vicinity of the bend at the Corner Stake Light, for a distance of 3,000 feet, the width had been increased to 400 feet, with mean low-water depths of from 13 to 14 feet. This latter work was done under contract with Thomas H. Benton, dated March 23, 1891, and has resulted in considerable improvement of the channel in regard to width, which, because of the sharp turn at the Corner Stake Light, should be as great as is consistent with the maintaining power of the current.

The expenditures during the past fiscal year amount to $6,665.32, $5,891.32 of which was an outstanding liability under the above-mentioned contract, which was completed June 29, 1891, the remaining $774 having been for office expenses.

No work has been done during the past fiscal year other than office work on the maps and records.

The amount of commerce reported for the calendar year 1891 is 9,219,481 tons against 9,170,514 tons for 1890.

July 1, 1891, balance unexpended	$8,388.94
June 30, 1892, amount expended during fiscal year	6,665.32
July 1, 1892, balance unexpended	1,723.62
Amount appropriated by act approved July 13, 1892	15,000.00
Amount available for fiscal year ending June 30, 1893	16,723.62
Amount (estimated) required for completion of existing project	46,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix F 5.)

6. *Passaic River, New Jersey.*—This river is being improved under two separate projects, the first applying to the river below Center Street Bridge, Newark, to and beyond the shoals in Newark Bay, a distance of 7⅝ miles, and the second to the upper course of the river from Center Street Bridge as far as Passaic, a distance of 8 miles.

a. Below Newark.—The lower portion of the river from Center Street Bridge to Newark Bay was first surveyed by the Engineer Department in 1879. The greatest depth in the channel at a point above the Elbow Beacon was only 7.1 feet, and in many places the greatest depth was 7.5 feet at mean low water.

A project was adopted, based on this survey, providing for obtaining by diking and dredging a channel 200 feet wide and 10 feet deep at mean low water from the Center Street Bridge to Newark Bay, at a cost of $232,875.

This project was modified in 1884, pursuant to the river and harbor act of that year, providing for extending the dike at the mouth of the river into the bay, a distance of 12,000 feet, and for dredging a channel across the shoal in Newark Bay 200 feet wide and 10 feet deep at mean low water, increasing the original estimate to $353,875.

The amount expended to June 30, 1891, was $200,186.85.

With this amount 6,205 feet of dike had been built and the channel through the shoal in the bay, and the channel up the river to and 1,423 feet beyond the Newark and New York Railroad Bridge, dredged to the full dimensions as required by the adopted project. Thence for a distance of 1,150 feet upstream the channel had been redredged and given a width of 180 feet, and from this point to Lister Dock regulated to a width of 100 feet, with a uniform depth of 10 feet at mean low water throughout.

The expenditures during the fiscal year ending June 30, 1892, amount to $33,505.33. With this amount the channel between the Toll Bridge and Center Street Bridge, Newark, from Point-no-Point to Lister Dock was widened 100 feet, with a mean low-water depth of 10 to 11 feet for a distance of 4,000 feet, giving a total width of 200 feet throughout this distance, and, for an additional 3,000 feet, the existing 100-foot channel was increased in width by 125 to 150 feet, with the same depth, giving a total width of 225 to 250 feet; a bar below the Zinc Works Dock removed to the same mean low-water depth, with a width of 120 feet for a distance of 1,600 feet, and urgent necessary repairs made to the dike in Newark Bay.

The commerce of this river is reported for the year ending December 31, 1891, to be 1,528,565 tons against 1,484,045 tons for 1890, an increase of 44,520 tons.

July 1, 1891, balance unexpended	$39, 313. 15
June 30, 1892, amount expended during fiscal year	33, 505. 33
July 1, 1892, balance unexpended	5, 807. 82

b. Above Newark.—Before its improvement was undertaken the upper part of the river had a navigable 6-foot channel, except at Middle, Belleville, Rutherford Park, and Holzman bars, where the depths were 4.5 feet, 3.9 feet, 3 feet, and 3.5 feet, respectively.

The project of improvement was adopted in 1872 and provided for a channel across and above the shoals from 7½ to 6 feet deep, mean low water, and from 200 to 50 feet wide, to be obtained by dredging and diking, at a cost of $123,924. It was modified in 1885 by extending the channel below Middle Bar 1,500 feet to the Erie Railroad Bridge, increasing the estimate to $129,000, which was further increased in

1886 to $133,762. A further modification, to include the removal of Third River Bar, the redredging of bars formed by freshets, and removal of bowlders at various points in the river, increasing the estimate to $193,822, was approved October 6, 1890. At the same time that portion of the project which contemplated dredging between Middle Bar and the Erie Railroad Bridge was annulled.

The amount expended to June 30, 1891, was $130,134.67 and channels of the requisite depth had been dredged from 60 to 75 feet wide, excepting through Third River Bar, which is of recent formation.

The expenditures during the fiscal year ending June 30, 1892, amount to $5,542.39, with which a channel has been dredged through Third River Bar 100 feet wide and 6 feet deep at mean low water for a distance of 800 feet; below the bar the channel was increased in width by 40 feet, with the same depth for a distance of 700 feet, and by 20 feet for a further distance of 245 feet, giving a continuous channel through this reach having a width of 100 feet and depth of 6 feet, mean low water.

The last complete return of the commerce of this river was for the calendar year 1889, 315,437 tons; for the calendar year 1891 it is reported at 322,211 tons.

July 1, 1891, balance unexpended	$8,715.33
June 30, 1892, amount expended during fiscal year	5,542.39
July 1, 1892, balance unexpended	3,172.94

As the river and harbor act approved July 13, 1892, makes the appropriation for the two reaches of the river under one heading, the following consolidated money statement for Passaic River is presented:

July 1, 1891, balance unexpended	$48,028.48
June 30, 1892, amount expended during fiscal year	39,047.72
July 1, 1892, balance unexpended	8,980.76
Amount appropriated by act approved July 13, 1892	45,000.00
Amount available for fiscal year ending June 30, 1893	53,980.76
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	124,347.00

(See Appendix F 6.)

7. *Elizabeth River, New Jersey.*—This stream, which is 2⅝ miles in length from its mouth to the head of navigation at Broad street, Elizabeth, has a width of from 50 to 90 feet, and before its improvement the wharves in the city could only be reached at high water by vessels drawing less than 4 feet; its commerce was estimated at 45,000 tons annually. The range of the tide was about 4.7 feet at its mouth and 3.4 feet at Bridge street.

The project for the improvement was adopted in 1878 and provides for obtaining, by dredging, a channel 60 feet wide and 7 feet deep at high water from the mouth of the river to the head of navigation, at an estimated cost of $25,530; this was increased in 1882 to $43,160, the increase being due to advanced prices.

The amount expended under this project to June 30, 1891, was $27,265.

With this amount the channel had been dredged to the required depth to within 1,000 feet of Broad Street Bridge. The condition of the river has deteriorated since work was suspended in 1883.

Work under contract, dated March 23, 1891, was begun July 1, 1891, and completed October 3, 1891, the amount of material removed being 6,917 cubic yards. Under this contract shoals were removed from the river at the bend above South street, at South Street Bridge, at John street, at the bend in the river below John street, and at the New York and Long Branch Railroad Bridge, to a depth of 7 feet at mean high water, with widths of 30 to 50 feet, giving a 7-foot mean high-water channel with widths varying from 30 to 50 feet, from the mouth of the river to within 900 feet of Bridge Street Bridge, in the town of Elizabeth.

The expenditures during the fiscal year ending June 30, 1892, amount to $4,621.20 for dredging under contract and administration.

July 1, 1891, balance unexpended	$4,735.00
June 30, 1892, amount expended during fiscal year	4,621.20
July 1, 1892, balance unexpended	113.80
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,113.80
Amount (estimated) required for completion of existing project	6,160.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix F 7.)

8. *Rahway River, New Jersey.*—In its original condition the Rahway River had a depth of 8 feet and more at mean high water from its mouth to Bricktown, 3⅝ miles; 7 feet to Edgar Dock, 4¼ miles; 4.4 feet to Milton Avenue Bridge, 4¾ miles; and 4 feet to Main Street Bridge, 5 miles, in the town of Rahway. Its commerce was estimated at 120,000 tons, and three attempts had been made to establish a line of steamboats on the river, but had failed on account of the bad condition of the stream.

The original project for its improvement was adopted in 1878 and provided for dredging a channel 125 feet wide and 8 feet deep at high water from Bricktown to Milton Avenue Bridge and 100 feet wide from that point to Main Street Bridge. The tide rises about 5 feet at the mouth and 4 feet at the head of navigation.

The amount expended on this improvement to June 30, 1891, was $37,000.

With the above amount the channel had been given a depth of 7 feet at mean high water and width of from 100 to 50 feet to within 550 feet of the head of navigation. It has, however, not proved permanent. The commerce of the river had not increased, though freight rates to Rahway had been materially reduced as a result of the improvement of the stream.

There has been no appropriation for this work since 1882 and there have been no funds for expenditure since the fiscal year ending June 30, 1890.

Amount (estimated) required for completion of existing project	$29,250.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix F 8.)

9. *Raritan River, New Jersey.*—Before its improvement by the United States the Raritan River had a depth of 8.5 feet at "The Stakes," 3 miles; of 6.5 feet at the "Middle Grounds," 4½ miles; of 7.5 feet at Whitehead Sand Dock, 8½ miles, and between this point and New Brunswick, 12¼ miles above the mouth, the channel was obstructed by a number of rocky shoals, with depths of from 8.4 to 6.9 feet at mean low water. The

city of New Brunswick and the Delaware and Raritan Canal, which terminates here, together with extensive brickyards on the South River, did a large commerce on the stream, estimated in 1871 at 3,053,857 tons per annum.

The present project was adopted in 1874 and provides for obtaining, by diking and dredging, and, where necessary, by drilling and blasting rock, a channel 200 feet wide and 10 feet deep, mean low water, from the mouth to New Brunswick, at a cost of $2,093,662.05. It was modified in 1881, pursuant to the river and harbor act of that year, by adding to it the dredging of the South Channel, about 13,000 feet long, 100 feet wide and 5½ feet deep at mean low water, from Kearney's Dock to Crab Island.

The amount expended to June 30, 1891, under this project was $534,206.58.

The above amount was expended in the construction of certain dikes required by the project at "The Stakes" and "Middle Grounds" in dredging channels 200 feet wide and 12 feet deep at mean low water at these points, and in blasting and dredging a channel of the same dimensions across the rocky shoal at Whitehead Sand Dock, and thence up the river with a width of 100 feet and depth of 10 feet to within 2,800 feet of the canal lock at New Brunswick. Under two special allotments made for it in the acts of March 3, 1881, and August 2, 1882, the south channel was dredged to the required depth for a distance of 4,000 feet. These improvements have been of great benefit to navigation, permitting the large tows in use on the river to reach a point 2,800 feet below New Brunswick at all stages of the tide. The commerce of the river is reported for the calendar year 1891 to be 1,566,888 tons, against 1,661,425 tons for 1890.

The expenditures during the fiscal year amount to $21,282.60. With this amount the channel has been given a width of 100 feet and depth of about 10 feet, at mean low water, for a distance of 520 feet through a river bed of extremely hard shale rock, bringing the 100-foot channel to within 2,280 feet of the canal lock at New Brunswick. Repairs requisite to the proper maintenance of the dike at the "Middle Grounds" were also made.

July 1, 1891, balance unexpended	$37,043.42
June 30, 1892, amount expended during fiscal year	21,282.60
July 1, 1892, balance unexpended	15,760.82
July 1, 1892, outstanding liabilities	1,723.59
July 1, 1892, balance available	14,037.23
Amount appropriated by act approved July 13, 1892	40,000.00
Amount available for fiscal year ending June 30, 1893	54,037.23
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	1,482,412.05

(See Appendix F 9.)

10. South River, New Jersey.—Before the improvement of this stream was undertaken by the United States the navigation of the lower 2½ miles of its course had been abandoned and a canal dredged at private expense from a short distance below Washington to Sayreville, on the Raritan River. In 1880, when the present project for improving the river was adopted, the mouth of this canal, on account of its faulty location, had shoaled to a depth of 4.6 feet at mean low water, and the best depth in the canal, some distance above, had decreased to 3.3 feet.

Above Washington a depth of 2.7 feet existed to Bissetts, 3⅝ miles, and of 2.5 feet to Old Bridge, the head of navigation, 6¼ miles above the mouth of the canal at Sayreville.

The present project, adopted in 1880, provides for closing the river below the head of the canal, correcting the direction of the mouth of the latter and obtaining by diking and dredging a depth of 8 feet, mean low water, to Washington, 6 feet to Bissetts, and 4 feet to Old Bridge, straightening the channel at two points by cutting across the meadow. It was estimated to cost $194,695.

The amount expended under this project to June 30, 1891, was $64,400.42.

With this amount the direction of the mouth of the canal had been changed, the dikes below Washington completed, and a small amount of dredging done on a shoal above Washington. A shoal at the mouth of Washington Canal has been removed and a channel dredged 60 feet wide through the canal and 50 feet wide across the shoal in the river below Washington.

The expenditures during the fiscal year ending June 30, 1892, amount to $5,152.45. With this amount the channel below the draw of the Raritan River Railroad Company's bridge was given a depth of 4 feet at mean low water, with additional width of 25 feet for a distance of 350 feet, and for a like distance above the bridge the width was increased to 70 feet. At Rourke Reach the channel was given a depth of 6 feet at mean low water and width of 60 feet for a distance of 860 feet; in addition a bar opposite Whitehead's brickyard was removed to a depth of 8 feet at mean low water and width of 60 feet for a distance of 450 feet, and at the junction of the canal and South River a channel was excavated 350 feet long, 60 feet wide, and 6 feet deep at mean low water. Vessels drawing 6 feet can now reach the Turnpike Bridge, about 2.4 miles from the mouth, at all stages of the tide.

The commerce of the river was reported for the calendar year 1890 to be 364,154 tons and for the calendar year 1891 it is given as 370,335 tons.

July 1, 1891, balance unexpended	$6,599.58
June 30, 1892, amount expended during fiscal year	5,152.45
July 1, 1892, balance unexpended	1,447.13
Amount appropriated by act approved July 13, 1892	7,000.00
Amount available for fiscal year ending June 30, 1893	8,447.13
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	116,695.00

(See Appendix F 10.)

11. Keyport Harbor, New Jersey.—Keyport Harbor was originally accessible at low water only to vessels drawing less than 4 feet. Before its improvement was undertaken by the United States a 6-foot channel had been dredged at private expense, which had shoaled in 1872 to 5½ feet and in 1882 to 5 feet, the range of the tide being 4.7 feet. A large commerce was carried on, however, valued at $2,932,000.

The project for the improvement was adopted in 1873 and provided for dredging a channel 4,700 feet long, 8 feet deep at mean low water, and 200 feet wide from the steamboat dock to the 8-foot contour in Raritan Bay, at an estimated cost of $30,475. The revised estimate of 1884 was $40,475.

The amount expended on this improvement to the close of the fiscal year ending June 30, 1891, is $30,475.

With the above amount a channel had been dredged from the 8-foot depth in Raritan Bay to Keyport wharf, a distance of 5,000 feet, with a width of 200 feet for the first 4,200 feet and 160 feet for the remainder.

There has been no appropriation for this work since 1882 and there have been no funds for expenditure since the fiscal year ending June 30, 1890.

The commerce of Keyport Harbor is reported for the calendar year 1891 to be 241,252 tons against 222,965 tons for 1890.

Amount appropriated by act approved July 13, 1892	$5,000.00
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	5,000.00

(See Appendix F 11.)

12. Mattawan Creek, New Jersey.—Before its improvement by the United States this small stream was obstructed at its entrance into Keyport Harbor by a mud flat, on which the best depth at the worst section was 3.1 feet at mean low water, though the 3-foot channel was too narrow and tortuous for use. Above this flat a good 4-foot channel existed to 1⅛ miles above the mouth, and thence to the steamboat dock at Mattawan 3.5 feet, shoaling to 1.8 feet at the freight dock 600 feet above and 1¼ miles from the mouth. The range of the tide is 4.7 feet. Notwithstanding the above difficulties it carried commerce valued in 1880 at $800,000.

The project for the improvement was adopted in 1881 and provides for dredging a channel 4 feet deep at mean low water and 100 feet wide from the mouth to Winkson Creek, and thence 75 feet wide to the railroad bridge at Mattawan, 250 feet above the freight dock, at an estimated cost of $33,120.

To June 30, 1891, the amount expended under this project was $21,000, with which a channel had been dredged giving the required depth from the mouth to the freight dock at Mattawan, with widths varying from 100 to 30 feet. No work of improvement had been done during the fiscal year ending June 30, 1891, though a contract was entered into March 21, 1891, for the removal by dredging of about 5,300 cubic yards of material.

Work under the above contract was begun September 9, 1891, and completed September 26, by the removal of 5,028 cubic yards of material. Under the contract the channel on the north side was given an additional width of 35 feet for a distance of 1,420 feet upstream from the mouth of the creek, giving a continuous channel with widths varying from 90 to 125 feet and depth of 4 feet at mean low water from Keyport Harbor to the mouth of the creek.

The expenditures during the fiscal year have been for dredging under contract and office expenses, and amount to $2,485.87.

The commerce for the calendar year 1891 is reported to be 199,850 tons, against 187,850 tons for 1890, an increase of 12,000 tons.

July 1, 1891, balance unexpended	$2,500.00
June 30, 1892, amount expended during fiscal year	2,485.87
July 1, 1892, balance unexpended	14.13
Amount appropriated by act approved July 13, 1892	9,620.00
Amount available for fiscal year ending June 30, 1893	9,634.13

(See Appendix F 12.)

13. *Shoal Harbor and Compton Creek, New Jersey.*—Shoal Harbor is an indentation of the shore on the south side of Sandy Hook Bay, 5 miles west of the entrance to Shrewsbury River. It is bare at low water and the water deepens so gradually outward that the 5-foot curve, mean low water, is only reached at a distance of 3,000 feet from the high-water line. Compton Creek, which flows into Shoal Harbor, is 5 to 6 miles long, with 3 to 5 feet of water in the lower reach. At one-quarter of a mile from its mouth it is crossed by a fixed bridge, beyond which no boats ever go. Between this bridge and the harbor there is a harbor of refuge of limited capacity, having a depth of 9 feet of water in places, to which fishing vessels resort when the tides allow them to cross the shoal at the entrance. The range of tides is 4.5 feet.

The plan of improvement adopted in 1884 had in view the connection of the 5-foot mean low-water curve of the creek on the inside with the 5-foot curve of the bay, by means of a dredged channel 150 feet wide, and the protection of this channel against shoaling by means of a timber dike placed on the west side of the harbor, at a total estimated cost of $64,130.

The amount expended to the close of the fiscal year ending June 30, 1891, exclusive of outstanding liabilities, was $1,649.80.

The expenditures during the fiscal year ending June 30, 1892, amount to $3,350.20.

Ten thousand eight hundred and eight cubic yards of material was removed during the fiscal year ending June 30, 1891, and 4,921 from the beginning of the present year to July 29, 1891, making a total of 15,729 cubic yards. The condition of the creek after the completion of the contract showed an improved channel with a mean low-water depth of 4½ feet, commencing in the mouth of the creek and extending a distance of 1,200 feet, with a width of 100 feet for the first 800 feet of its length and 70 feet for the remainder.

The commerce of the creek has increased, being reported, for the calendar year 1891, as 48,000 tons, against 35,500 tons for 1890.

July 1, 1891, balance unexpended	$3,350.20
June 30, 1892, amount expended during fiscal year	3,350.20
Amount appropriated by act approved July 13, 1892	3,000.00
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	56,130.00

(See Appendix F 13.)

14. *Shrewsbury River, New Jersey.*—When the present project for this improvement was adopted, in 1879, the river was obstructed by a number of shifting sand-bars, which had caused the complete suspension of navigation in the South Branch and only permitted the passage of vessels engaged in commerce up the North Branch at or near high water. A considerable trade was carried on, however, even under these difficult conditions.

The originally adopted project for the improvement was to dredge a channel 6 feet deep at mean low water, and from 300 to 150 feet in width, across the shoals from the mouth to Red Bank, on the North Branch, 8 miles, and Branchport, on the South Branch, 9 miles, maintaining these channels by longitudinal dikes. This project has not been modified as to the end sought, but estimates of the diking, dredging, and cost have been increased from time to time.

The amount expended on this project to the end of the fiscal year ending June 30, 1891, was $218,498.10.

With this amount numerous dikes have been built and maintained and channels dredged in various parts of both branches and main stem, 6 feet deep and from 25 to 100 feet wide. These improvements have resulted in a marked increase in the commerce.

The amount expended during the fiscal year is $5,961.58; with this amount the channel in the South Branch, between Sedge Island and Seabright, was redredged to a depth of 6 feet at mean low water and width of 100 feet, for a distance of 900 feet; a shoal in the channel of the North Branch above Upper Rocky Point removed to a depth of 6 to 7 feet at mean low water and width of more than 100 feet, and slight necessary repairs made to the dike at the mouth of the river.

The commerce of the river was reported for the calendar year 1890 to be 556,500 tons; this has increased to 623,000 tons for the calendar year 1891.

July 1, 1891, balance unexpended	$6,001.90
June 30, 1892, amount expended during fiscal year	5,961.58
July 1, 1892, balance unexpended	40.32
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	10,040.32
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	20,062.00

(See Appendix F 14.)

15. *Manasquan* (*Squan*) *River, New Jersey.*—In its original condition this stream had a depth of from 4 to 6 feet at mean low water for several miles above its mouth, but was obstructed at its outlet into the ocean by a sand spit, which had deflected the stream into a channel parallel with the beach communicating with the ocean across shifting sand bars, on which the best depth did not exceed 1½ feet at mean low water; mean range of tide, 2.4 feet. In severe storms this channel was sometimes entirely closed by the sand, remaining so until the fresh water in the river had accumulated sufficiently to force a new outlet. Under these conditions the river could not be used by commerce.

The project for its improvement was adopted in 1879, and contemplated dredging the lower river and obtaining by means of jetties a permanent outlet nearly at right angles to the beach, with a depth of 6 feet at mean low water, at an estimated cost of $52,120. This was increased to $72,000 in 1882, the increase being due to advanced prices and to a proposed increase in the length of the jetties.

The amount expended under this project to June 30, 1891, was $39,000.

With this amount two jetties had been constructed, but neither to its full length, appropriations having ceased in 1882. No permanent improvement had been effected.

An appropriation of $2,000 was made in the act of September 19, 1890, to be expended in the removal of obstructions placed by the Government at the mouth of the river, if in the discretion of the Secretary of War the same should be done. There were no expenditures on account of this work during the fiscal year ending June 30, 1892, as the removal of the obstructions alluded to in the act of September 19, 1890, was, in the opinion of the engineer in charge, deemed unnecessary, and so reported under date of December 19, 1890, and was approved by the Secretary of War December 30, 1890.

July 1, 1891, balance unexpended	$2,000.00
July 1, 1892, balance unexpended	2,000.00
Amount (estimated) required for completion of existing project	31,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix F 15.)

IMPROVEMENT OF DELAWARE RIVER, PENNSYLVANIA AND NEW JERSEY, SCHUYLKILL RIVER, PENNSYLVANIA, AND RIVERS IN SOUTHERN NEW JERSEY; HARBOR IMPROVEMENTS IN DELAWARE RIVER AND BAY; CONSTRUCTION OF PIER AT LEWES, DELAWARE; DELAWARE BREAKWATER, DELAWARE.

Officer in charge, Maj. C. W. Raymond, Corps of Engineers, with Lieut. Albert M. D'Armit, Corps of Engineers, under his immediate orders since May 18, 1892; Division Engineer, Col. William P. Craighill, Corps of Engineers, to April 1, 1892, and Col. Henry L. Abbot, Corps of Engineers, since that date.

1. *Delaware River, Pennsylvania and New Jersey.*—Trenton, the head of natural navigation on the Delaware River, is about 30 miles above the upper part of the port of Philadelphia. In its original condition this part of the river was obstructed by shoals at the following localities: Between Bordentown and Trenton, a distance of about 5 miles, a narrow and circuitous channel existed, which carried from 3 to 6 feet at mean low water; at Kinkora Bar, about 9 miles below Trenton, a shoal carrying from 7 to 8 feet, and at Five Mile Bar, at the upper part of Philadelphia, a shoal across the Pennsylvania channel carrying only 3 or 4 feet at mean low water, there being, however, 13 feet of water past Five Mile Bar, in the New Jersey channel, passing south of Petty Island.

Below Philadelphia the river, in its original condition, presented obstructions at Mifflin Bar which reduced the depth at mean low water to 17 feet, at Schooner Ledge and Cherry Island Flats to 18 feet, at Bulkhead Shoal and Dan Baker Shoal to about 20 feet.

In that part of the Delaware River between Trenton, N. J., and Bridesburg, Pa., efforts in the past have been directed toward relieving commerce from the obstructions which exist in the upper 9 miles of the river, or that part between Kinkora Bar and Trenton. A detailed survey of the river between Bridesburg and Trenton has been made for the purpose of obtaining the necessary data for determining upon a plan for the improvement of the river between Trenton and the upper part of Philadelphia to meet the requirements of commerce.

Previous to 1885 the efforts to improve the river between Philadelphia and the bay have been confined to dredging, except at Schooner Ledge, where solid rock has been removed, under appropriations for special localities, and also under general appropriations for the Delaware River below Bridesburg.

A Board of Engineers, convened by direction of the Secretary of War for the purpose of considering the subject of the permanent improvement of Delaware River and Bay, recommended, under date of January 23, 1885, the formation of a ship channel from a point opposite Philadelphia and about midway between the American Shipbuilding Company's yard and the Gas Trust Wharf to deep water in Delaware

Bay, having a least width of 600 feet and a depth of 26 feet at mean low water. The formation of such a channel is to be obtained, except at Schooner Ledge, where rock would require to be removed, by regulating the tidal flow by means of dikes, with recourse to dredging, where necessary, as an aid to such contracting and regulating works. The estimated cost of obtaining a channel of the above dimensions is about $2,425,000, which covers the estimated cost of the permanent improvement of the Delaware River between the upper part of Philadelphia and deep water in the bay. This estimate of cost does not include the improvement of Philadelphia Harbor, which is a separate project. With the present requirements of commerce above Philadelphia, it is not considered that the part of the river lying between Trenton and Bridesburg demands any further improvement.

The entire amount expended on the improvement of the Delaware River from 1836 to June 30, 1891, under appropriations both for special localities and the general river, was $1,980,359.55, of which $117,961.27 was expended on that part of the river between Trenton and the upper part of Philadelphia. As a result of this expenditure there had been formed at the latter date a channel of navigable width and 7½ feet deep at mean low water through the bars between Bridesburg and Bordentown; a channel across Kinkora Bar 9½ feet deep; a channel across Five Mile Bar 13 feet deep; a channel from 200 to 400 feet wide and from 24 to 26 feet deep through the shoal areas at Port Richmond; a channel across Mifflin Bar from 150 to 250 feet wide and from 24 to 26 feet deep; a channel through Schooner Ledge 330 feet wide and 24 feet deep, except over a small area discovered in 1889, where the depth is reduced to 23 feet at mean low water; a channel through Cherry Island Flats from 200 to 450 feet wide and from 24 to 26 feet deep, and a channel across Bulkhead Shoal 600 feet wide and from 20 to 21 feet deep.

The channel between Philadelphia and Camden across Smith Island Bar had been improved by the formation of a dredged cut protected by revetment, so as to give a channel 100 feet wide, with a minimum depth of 6 feet at mean low water.

During the fiscal year ending June 30, 1892, the sum of $100,362.21, which includes the liabilities outstanding June 30, 1891, was expended in surveys, examinations, and in dike construction and dredging at Kinkora and Bulkhead bars, making a total expenditure since 1836 of $2,080,721.76, of which $728,721.76 has been expended on present project.

The changes which have resulted during the past fiscal year are summarized as follows:

At Kinkora Bar stone has been placed in the dike to fill depressions caused by settlement. The dredged channel has shoaled considerably and the line of deepest water has moved to the westward. The minimum depth at mean low water across the bar is now 8 feet. At Five Mile Bar the dike has formed a channel from 12 to 13 feet deep at mean low water and from 200 to 300 feet wide. At Mifflin Bar the channel now carries a depth of 25 feet, with a minimum width of 200 feet and a depth of 24 feet, with a minimum width of 350 feet. At Cherry Island Flats the channel, which was dredged to a depth of 24 feet between 1879 and 1884, has shoaled about 1 foot over a distance of about 10,000 feet and deepened over the remaining distance. At Bulkhead Bar the east dike has been practically completed, and under its action, assisted by dredging, a channel has been formed across the bar with a depth of 26 feet at mean low water and a mininum width of 100 feet. The 24-foot channel has a minimum width of 370 feet.

During the present year it is proposed to apply available funds to deepening and widening the channel through Cherry Island Flats and to the continuation of dike construction for the improvement of Baker Shoal.

July 1, 1891, balance unexpended		$271, 640. 45
June 30, 1892, amount expended during fiscal year		100, 362. 21
July 1, 1892, balance unexpended		171, 278. 24
July 1, 1892, outstanding liabilities	$4, 629. 67	
July 1, 1892, amount covered by uncompleted contracts	4, 122. 23	
		8, 751. 90
July 1, 1892, balance available		162, 526. 34
Amount appropriated by act approved July 13, 1892		50, 000. 00
Amount available for fiscal year ending June 30, 1893		212, 526. 34
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		1, 675, 000. 00

(See Appendix G 1.)

2. *Harbor between Philadelphia, Pennsylvania, and Camden, New Jersey.*—The islands in the Delaware River between Philadelphia and Camden compel the flood and ebb currents to pursue different paths, narrow the existing channels, and prevent the extension of wharves necessary for the purposes of commerce. The plan of improvement originally adopted by Congress provides for the removal of Smith and Windmill islands and a part of Petty Island, and the formation of a channel of ample depth and about 2,000 feet in width from Kaighn Point to Fishers Point. The project contemplates the advance of wharves and bulkheads on both the Philadelphia and Camden shores during the progress of the work. The excavation is to be done by the General Government. The advance of wharves and bulkheads is under the control of the local authorities and private owners, a portion of the material to be removed by the Government being considered available for the necessary filling. The estimated cost of the work to be done by the United States, exclusive of the cost of the islands, is $3,500,000.

The project was modified by Congress in the sundry civil act approved March 3, 1891, so as to require that all material removed under appropriations made to that date should be deposited and spread on League Island.

During the fiscal year ending June 30, 1891, a contract was entered into with James A. Mundy & Co., of Philadelphia, Pa., for all the work required for the improvement. Under this contract 10,318 cubic yards of material was dredged from Windmill Island and work was in progress upon the removal of 1,260 feet of revetment. A hydrographic survey was made before the commencement of the work. Harbor lines were established. The amount expended during the year was $9,848.17.

During the fiscal year ending June 30, 1892, under the contract with James A. Mundy & Co., 2,330 linear feet of piling and revetment inclosing Windmill Island have been wholly removed, and 923 linear feet have been removed to the level of low water; 312,111 cubic yards of material have been dredged from Windmill Island and the adjacent shoal; about 35,000 cubic yards have been removed by scour, and 287,736 cubic yards have been deposited on League Island. The amount expended during the year was $54,182.48.

The accepted work of excavation since the beginning of the improvement has cost $35,718.29. The filling at League Island has cost $27,334.92.

Repeated surveys have been made to determine the changes in progress.

The contractors expect to excavate 250,000 cubic yards of material during July, 1892, and at least 300,000 cubic yards per month thereafter.

July 1, 1891, balance unexpended		$689, 973. 92
June 30, 1892, amount expended during fiscal year		54, 182. 48
July 1, 1892, balance unexpended		635, 791. 44
July 1, 1892, outstanding liabilities	$19, 524. 54	
July 1, 1892, amount covered by uncompleted contracts	616, 266. 90	
		635, 791. 44
Amount appropriated by act approved August 5, 1892		41, 000. 00
Amount (estimated) required for completion of existing project		2, 759, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1894		500, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix G 2.)

3. *Schuylkill River, Pennsylvania.*—When the work of improvement was commenced in 1870 there was a channel of entrance into the mouth of the river carrying a depth of only 10 feet at mean low water.

The original project under which work was commenced in 1870 proposed the formation of a channel 100 feet wide, with a depth of 20 feet from the mouth of the river to Gibson Point, about 4 miles, and a depth of 18 feet from thence to Chestnut Street Bridge in Philadelphia, about 3 miles.

In 1875 and 1883 this project was amended so as to increase the low-water channel between the mouth and Girard Point, a distance of about 1 mile, to 400 feet wide and 24 feet deep, and from Girard Point to Gibson Point, about 3 miles, to 250 feet wide and 20 feet deep.

The amount expended upon these projects to June 30, 1891, was $413,732.71. This work had resulted in the formation of a channel about 100 feet wide and from 18 to 20 feet deep at mean low water across the bar at the river's mouth; a channel about 250 feet wide and from 20 to 24 feet deep from inside the bar to Point Breeze, except at Yankee Point, where the width is 300 feet; and from Point Breeze to Gibson Point, a channel from 100 to 200 feet wide and from 18 to 20 feet deep; from thence to Chestnut Street Bridge, a channel of navigable width and from 17 to 20 feet deep.

During the fiscal year ending June 30, 1892, the sum of $1,299.07 was expended in dredging in the channel above Penrose Ferry Bridge to remove a dangerous obstruction, in surveys at the mouth, and in the preparation of a project for the improvement of the channel across the bar by means of dikes. During the month of June, 1892, contracts were entered into for the construction of dikes at the mouth of the river.

All the work contemplated by the project under which the improvement has heretofore been carried on will be completed with the appropriation made by the river and harbor act approved July 13, 1892. A project for additional work at the mouth of the river (given in full with the annual report of the officer in charge) was approved April 26, 1892; the cost of completing the work under this modified project is estimated at $44,959.

July 1, 1891, balance unexpended		$25,017.29
June 30, 1892, amount expended during fiscal year		1,299.07
July 1, 1892, balance unexpended		23,718.22
July 1, 1892, outstanding liabilities	$138.10	
July 1, 1892, amount covered by uncompleted contracts	15,657.00	
		15,795.10
July 1, 1892, balance available		7,923.12
Amount appropriated by act approved July 13, 1892		46,250.00
Amount available for fiscal year ending June 30, 1893		54,173.12
Amount (estimated) required for completion of existing project		44,959.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix G 3.)

4. *Ice harbor at Marcus Hook, Pennsylvania.*—This work, in its present plan, was commenced in 1866, the object being to provide a harbor in the Delaware River to protect vessels against moving ice.

In 1785 the Commonwealth of Pennsylvania built, for the convenience of commerce, piers at Marcus Hook, extending from the shore line into the river. It is assumed that at some subsequent time these shore piers were turned over to the United States, since in 1829 an appropriation was made of $5,000 for repairing these piers, improving the harbor, and removing obstructions. No further appropriation was made until 1866.

At this latter date the project was adopted for the construction of detached piers in the harbor, consisting of stone superstructures upon crib foundations filled with stone, together with the deepening of the harbor by dredging.

In 1881 it was proposed to increase the area of the harbor by the construction of a bulkhead about 1,800 feet in length parallel to the shore line, and about 150 feet outside of high-water line and the deepening of this added area by dredging. Nothing was done towards the carrying into effect of the modification of 1881, on account of the objections of some of the abutting property owners, and in 1888 this hitherto proposed modification was abandoned and an increased depth proposed for the areas protected by the detached piers outside of the natural shore line of the river.

The amount expended from 1866 to June 30, 1891, was $208,963.64, and resulted in the construction of two shore or landing piers and seven detached ice piers, the deepening by dredging of the area protected by the piers, and the placing of mooring piles within the harbor. By this expenditure a harbor was formed with an area of about 10 acres, carrying a depth of from 12 to 25 feet at mean low water.

During the fiscal year ending June 30, 1892, $36.36 was expended in examining the harbor with a view to making necessary repairs and in office expenses. A contract was made for the repair of landing piers and the replacement of mooring piles. The funds remaining after the execution of this work will be held for such incidental repairs as may be required from time to time.

July 1, 1891, balance unexpended		$5,036.36
June 30, 1892, amount expended during fiscal year		36.36
July 1, 1892, balance unexpended		5,000.00
July 1, 1892, outstanding liabilities	$111.24	
July 1, 1892, amount covered by uncompleted contracts	1,014.34	
		1,125.58
July 1, 1892, balance available		3,874.42

(See Appendix G 4.)

5. *Ice harbor at head of Delaware Bay, Delaware.*—The act of August 2, 1882, appropriated $25,000 for the commencement of work on the ice harbor at the head of Delaware Bay, to include the removal of some sunken piers, the remains of an old ice harbor, in the channel east of Reedy Island, Delaware.

The desirability of an ice harbor at the head of Delaware Bay has been long recognized, but until the improvement of the main ship channel shall have been materially advanced it is believed that appropriations can be applied, with better results to commerce, to the improvement of the channel rather than to the formation of an ice harbor suited to the requirements of the case. As to location, the prevailing judgment would place the ice harbor at or very near Liston Point, but since the works already planned for the improvement of the channel in this part of the river involve the construction of about 11 miles of dikes, the changes which may result from such extensive constructions render the prior location of an ice harbor hazardous.

The amount expended to June 30, 1891, was $8,763.07, of which $3,700 was applied to the removal of the sunken piers back of Reedy Island, as provided in the act of August 2, 1882, making the appropriation of $25,000. The balance was expended in surveys, examinations, preliminary studies, and office expenses.

During the fiscal year ending June 30, 1892, no expenditures were made.

July 1, 1891, balance unexpended	$16,236.93
July 1, 1892, balance unexpended	16,236.93

(See Appendix G 5.)

6. *Construction of iron pier in Delaware Bay, near Lewes, Delaware.*—The original project for this work proposed the construction of a landing pier about 1,700 feet in length, extending from the shore south of the breakwater into Delaware Bay to a depth of 22 feet at mean low water, the pier to consist of a substructure of wrought-iron screw piles surmounted with a timber superstructure. The work was commenced in 1871, and completed, except as to superstructure, in 1880.

The amount expended to June 30, 1890, was $368,453.66, and resulted in the construction of 1,155 linear feet of pier 21 feet in width, and 546 linear feet 42 feet in width, or a total length of 1,701 feet. The depth of water at the outer end of the pier head was about 21 feet at mean low water.

During the fiscal year ending June 30, 1891, $7,033 was expended in replacing about 200 linear feet of the pier destroyed by the collisions of wrecked vessels in 1889, and in placing fender piles along 1,200 linear feet of the shore arm of the pier. The total amount expended during the fiscal year ending June 30, 1891, including inspection and office expenses, was $9,623.89.

During the fiscal year ending June 30, 1892, $422.45 was expended in office expenses.

From the decayed condition of the timber superstructure of a large part of the pier it is not available for use by the railroad, to which the right was given to use the pier under the provisions of the act of July 15, 1870.

If the pier is to be rendered available for the general purposes of railroad traffic, as contemplated in the act above referred to, it will be necessary to replace the present decayed wooden superstructure by an iron construction, which has been estimated at $93,000.

The sundry civil act of March 3, 1891, contained the following provision:

> And the Secretary of War is hereby directed to assign to the Secretary of the Treasury so much space on the Lewes iron pier as may be necessary to enable the Marine-Hospital Service to establish and conduct thereon such disinfection machinery as may be required for the proper disinfection of the cargoes of vessels detained at the quarantine, and when the breakwater shall have been completed then the said pier shall be permanently assigned to the Treasury Department: *Provided*, That such occupation and use of the pier by the Marine-Hospital Service does not interfere with the engineering operations of the War Department in the completion of the breakwater improvement.

It is understood that the use of the pier as above provided will at times prohibit its use for any other purpose. The pier is of considerable value to vessels frequenting the breakwater harbor, being the only communication with the shore; it is necessary for the purpose of the Light-House Service, and its free use at all times will probably be indispensable for many years for the engineering operations of the War Department. It is not suitable for quarantine purposes, because the maximum depth at the end of the pier head is only about 21 feet at mean low water. The depth is still less on the sides. Since the pier is much exposed to storms, it could not be safely used in rough weather by vessels of a greater draft than about 15 feet. The great majority of vessels frequenting this harbor (including nearly all that arrive from foreign ports) could not generally be taken to this pier for the purpose of disinfection. It is therefore suggested that other arrangements be made for the requirements of the quarantine service.

July 1, 1891, balance unexpended	$422.45
June 30, 1892, amount expended during fiscal year	422.45

(See Appendix G 6.)

7. *Delaware Breakwater, Delaware.*—Under the act of Congress, May 7, 1822, $22,700 was appropriated for a survey of Delaware Bay, near Cape Henlopen, for the purpose of determining upon the site for a harbor of shelter. In 1828 an appropriation of $250,000 was made for commencing the work under a plan submitted by a board of commissioners appointed by Congress.

The project of the board contemplated the construction in the concavity of the bay, just inside Cape Henlopen, of two massive works on the pierres perdues or riprap system, separated by an interval or gap of 1,350 feet, the greater, called the breakwater, to afford safe anchorage during the gales from the north and east; the other, called the icebreaker, to protect shipping against northwesterly gales and the heavy drifting ice of the bay.

This project was completed in 1869, under aggregate appropriations, including the first for survey, of $2,192,103.70. The stone used in the work amounted to 892,528 gross tons, and varied from one-quarter of a ton to 7 tons in weight, the smaller constituting the bulk of the mass, the larger used to cover the exterior slopes.

As completed in 1869 the breakwater is 2,558 feet long, and the icebreaker 1,359 feet long on top. The average width on top is 22 feet, and at base 160 feet. The top is from 12 to 14 feet above mean low water.

In 1882 a project was adopted for closing the gap between the breakwater and the ice-breaker by means of a random stone foundation with a concrete superstructure. The random stone foundation was to be brought to a height of 12 feet below low water, with a width on top of 48 feet; the concrete superstructure to have a width on bottom of 24 feet, rising to a height of 12 feet above mean low water, with a width on top of 12 feet. The estimated cost of this project was $675,000.

In 1883 and 1884 the project was modified by providing a foundation of brush mattresses for the random stone superstructure and omitting the construction of a pile bridge across the gap, which formed part of the project of 1882 for closing the gap.

In 1890 the concrete superstructure was further modified by establishing its base at 15 feet below mean low water by making it rectangular in section, with a width of 27 feet and height of 27 feet, and by constructing the work to above the plane of high water of large concrete blocks, above which concrete in mass is to be used. The estimated cost of the modified project, including the $356,250 appropriated from 1882 to 1888 was $856,250.

In 1891 the random stone substructure having been practically completed, the project for the hitherto proposed concrete superstructure was modified by substitution of random stone for the remaining part of the work, so as to raise the structure to a height of 14 feet above mean low water, with a width on top of 20 feet, the width at low water to be 40 feet, and the slopes below this plane to be such as may be formed by the action of the sea, between low water and the top the slopes to be about 1 on 0.7 formed by heavy stones laid in position. The estimated cost of completing this part of the work is $320,000, or, including the $436,250 appropriated from 1882 to 1890, the cost of closing the gap is $756,250.

From the beginning of the work in 1822 to June 30, 1891, the total amount expended was $2,549,155.79, of which $357,052.09 was expended on the project of 1882 for closing the gap.

During the fiscal year ending June 30, 1892, the sum of $78,212.08 was expended in raising the structure in the gap to the level of mean low water over a distance of 1,006 feet. It is important that this work should be completed as soon as possible, since in its present condition it is a serious danger to commerce.

The increase in the dimensions and draft of vessels since the present harbor was designed in 1822, together with the shoaling which has ensued behind the breakwater, renders the present harbor under these changed conditions inadequate for the requirements of commerce. Upon the completion of the present project of closing the gap, additional anchorage area will be added to the harbor and make it of great and continued value to coasting vessels.

July 1, 1891, balance unexpended	$79,197.91
June 30, 1892, amount expended during fiscal year	78,212.08
July 1, 1892, balance unexpended	985.83
Amount appropriated by act approved July 13, 1892	50,000.00
Amount available for fiscal year ending June 30, 1893	50,985.83
Amount (estimated) required for completion of existing project	270,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix G 7.)

8. *Rancocas River, New Jersey.*—In its natural condition Rancocas River carried a minimum low-water depth of about 4½ feet between the

mouth and Centerton, a distance of about 7½ miles, and from Centerton to Mount Holly, a distance of about 5½ miles, a ruling depth of about 2½ feet.

The original project of 1881 proposed the formation, by a dike at Coats Bar and dredging elsewhere, of a channel from 150 to 200 feet wide and 6 feet deep at mean low water from the mouth to Centerton, and from thence to Mount Holly a channel 5 feet deep.

Operations were carried on under this project from 1881 to 1884, under appropriations aggregating $20,000 made in 1881 and 1882. To the close of the fiscal year ending June 30, 1891, $28,702.64 had been expended in the formation of a channel 100 feet wide and 6 feet deep at mean low water between the mouth and Centerton, and in the removal of three wrecks.

During the fiscal year ending June 30, 1892, $1,197.27 was expended in the formation of a channel 25 feet wide and 4 feet deep at mean low water between Centerton and Mount Holly.

July 1, 1891, balance unexpended	$1,197.27
June 30, 1892, amount expended during fiscal year	1,197.27
Amount appropriated by act approved July 13, 1892	5,000.00
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	46,000.00

(See Appendix G 8.)

9. *Alloway Creek, New Jersey.*—In its original condition Alloway Creek was obstructed between its mouth and Quinton, a distance of about 10½ miles, by shoal areas in the upper half of the stream, which reduced the low water depths to about 4 feet.

The original project of 1889 proposed the formation, by dredging, of a channel 6 feet deep at mean low water and 60 feet wide from Quinton to a point about 1,000 feet above the Upper Hancock Bridge; from thence a channel of the same depth and 75 feet wide to a locality known as the Square, where the work is to be supplemented by a dike. At a locality known as the Canal, in addition to a channel of the last-named dimensions, the width of the stream was to be increased to about 150 feet between its low-water lines.

The appropriation of $6,000 by the act of September 19, 1890, was the first made for this work.

During the fiscal year ending June 30, 1891, $3,467.88 was expended in deepening to 6 feet at mean low water the channel at the Canal, Square, and Upper Hancock Bridge.

During the fiscal year ending June 30, 1892, $2,131.73 was expended in deepening the channel. There are now channels 75 feet wide and 6 feet deep at mean low water through the worst bars at the Square, Canal, and Upper Hancock Bridge.

July 1, 1891, balance unexpended	$2,532.12
June 30, 1892, amount expended during fiscal year	2,131.73
July 1, 1892, balance unexpended	400.39
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	3,400.39
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	16,000.00

(See Appendix G 9.)

10. Maurice River, New Jersey.—In its original condition Maurice River had a depth of 5 feet at mean low water over the bar at its mouth and a channel of over 10 feet deep extending from its mouth for a distance of about 20 miles, or to within 4 miles of Millville. For the remaining distance of about 5 miles, to the head of navigation at Millville, there were shoal areas which reduced the low-water depth to about 2 feet.

The original project of 1882 proposed the formation, by dredging, of a channel 100 feet wide and 6 feet deep at mean low water through the 4 miles of river below Millville Bridge, and from thence to the head of navigation a channel of the same width and 4 feet deep. In 1891 the project was modified by extending the 6-foot channel to the head of navigation, and in 1892 by a further extension of 500 feet with a width of 50 feet.

At the close of the fiscal year ending June 30, 1891, $34,916.34 had been expended in the formation of a 6-foot channel from a point 4 miles below to about 1,400 feet above Millville Bridge.

During the fiscal year ending June 30, 1892, $8,083.77 was expended in the full completion of the improvement. The river is now navigable at all stages of the tide to a point 1,400 feet above Millville Bridge.

The estimated cost of this improvement was $112,000. The conditions having been very favorable, it has been completed at a total cost of $43,000.

July 1, 1891, balance unexpended	$8,083.77
June 30, 1892, amount expended during fiscal year	8,083.77

(See Appendix G 10.)

11. Removing sunken vessels or craft obstructing or endangering navigation.—During the past fiscal year the following wrecks were removed under the provisions of the act of June 14, 1880: The scow *Paddy Ryan*, from Rancocas River, New Jersey; the iron steamer *Nuphar*, from the outer bar at Townsend Inlet, New Jersey; the canal boat *Agatha Brady*, from Delaware River, opposite Fairmount avenue wharf, city of Philadelphia.

(See Appendix G 11.)

EXAMINATION, BY BOARD OF ENGINEERS, FOR LOCATION AND PLAN FOR HARBOR OF REFUGE FOR DEEP-DRAFT VESSELS NEAR MOUTH OF DELAWARE BAY, MADE IN COMPLIANCE WITH PROVISIONS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

In compliance with the provisions of the act a Board of Engineers, consisting of Col. Wm. P. Craighill, Maj. C. W. Raymond, and Capt. W. H. Bixby, Corps of Engineers, was constituted by the Secretary of War to examine "Delaware Bay, with a view of determining the best site near the mouth of the same for a national harbor of refuge suitable for deep-draft vessels," and submit "report thereon, with a project and estimate of cost of construction of such a harbor of refuge."

A preliminary report on the subject, dated December 11, 1890, was printed as Appendix G 22 of the Annual Report, Chief of Engineers, for 1891.

The final report, dated January 5, 1892, was submitted, transmitted to Congress, and printed as House Ex. Doc. No. 112, Fifty-second Congress, first session.

The plan and location proposed for the formation of a deep harbor of refuge at this locality contemplate the construction of a stone breakwater 1½ miles long extending in a general northwest and southeast direction on the east branch of the Shears, off Cape Henlopen, Delaware; and construction of a row of ten ice piers across the upper end of the harbor, to protect the anchorage against ice descending the bay. The total cost of this work is estimated at $4,665,000.

(See Appendix G 12.)

IMPROVEMENT OF RIVERS AND HARBORS IN DELAWARE AND ON EASTERN SHORE OF CHESAPEAKE BAY, MARYLAND AND VIRGINIA, AND OF INLAND WATER WAY FROM CHINCOTEAGUE BAY, VIRGINIA, TO DELAWARE BAY, DELAWARE.

Engineer in charge, William F. Smith, United States agent, Major of Engineers, U. S. Army, retired; Division Engineer, Col. William P. Craighill, Corps of Engineers.

1. *Wilmington Harbor, Delaware.*—Previous to 1836, when the first appropriation for the improvement of Christiana River was made, the depth of water at the entrance was about 8½ feet. The minimum depth in the channel of the portion of the river below Third Street Bridge was 8 feet. This depth was increased by dredging in that year to 10 feet. Under a project commenced in 1871 and completed in 1881, a 12-foot channel from 100 to 200 feet wide was made from the mouth to above the city of Wilmington. The present project was adopted in 1881 and is for a 15-foot low-water channel from the mouth of the river to the Pulp Works, with a width of 150 feet from the mouth to the Rolling Mill Wharf; 100 feet to the Delaware and Western Railroad Bridge; and 75 feet to the Pulp Works. The project included further, a channel 12 feet deep and 50 feet wide from the latter works to the Delaware Railroad Bridge and the construction of a jetty on the north side of the mouth of the river. Dredging operations and the construction of the jetty were begun in the following year. The original estimate was $175,551, which was increased in 1883 to $191,384 by changing the width of the proposed channel to 150 feet throughout. In 1884 the project was amended by raising the height of the jetty 4 feet; an extension of 322 feet to the jetty as then built was also proposed and approved, but has not yet been carried out.

Up to the close of the fiscal year ending June 30, 1891, the sum of $188,057.83 had been expended under this project. There was then an improved channel 15 feet deep at low water and 150 feet wide between the Delaware River and a point about 600 feet above the Third Street Bridge of a total length of 5,200 feet.

During the fiscal year ending June 30, 1892, dredging operations under a contract previously made were continued. The contract was completed August 14, 1891, the dredged channel having been extended 1,000 feet since July 1, reaching the Pusey & Jones shipyard.

July 1, 1891, balance unexpended	$15,692.17
June 30, 1892, amount expended during fiscal year	13,346.83
July 1, 1892, balance unexpended	2,345.34
Amount appropriated by act approved July 13, 1892	40,000.00
Amount available for fiscal year ending June 30, 1893	42,345.34
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	47,634.00

(See Appendix H 1.)

2. Ice harbor at New Castle, Delaware.—This ice harbor is one of the oldest in the Delaware River, its construction for the protection of vessels against floating ice having been commenced during colonial times. Since the beginning of the present century its improvement has been carried on by the General Government at various intervals, the total amount expended up to the close of the fiscal year ending June 30, 1891, being $223,593.15.

During the fiscal year ending June 30, 1892, a new ice-pier was constructed in the harbor under contract with the Delaware Construction Company of Wilmington, Del., at a cost of $9,500. The pier was begun on October 1 and was completed on December 28, 1891. Whilst this work was going on, the contractor also removed, under the same contract, one of the old piers (H), which had been in a dangerous condition. During the past year the harbor lines, approved by the Secretary of War on June 26, 1891, were permanently located.

The existing project as far as it relates to the construction of ice-piers is completed. The harbor in its present condition affords the best shelter on the Delaware River for deep-draft vessels in winter, and the necessity for increasing the protected area is already apparent.

July 1, 1891, balance unexpended	$15, 190. 79
June 30, 1892, amount expended during fiscal year	11, 343. 99
July 1, 1892, balance unexpended	3, 846. 80

(See Appendix H 2.)

3. Appoquinnimink River, Delaware.—This stream is a tidal tributary of Delaware Bay, flowing through New Castle County, Del. It is navigable for vessels of light draft from the mouth to above Odessa. A bar having only 1½ feet of water over it at low tide obstructs the mouth of the river. The average rise and fall of the tide at the bar is 6 feet; at Odessa it is 3.2 feet.

The project for improvement proposed in a report on a survey of the river made in 1889 and adopted under an appropriation made by the river and harbor act approved September 19, 1890, provides for dredging a channel 8 feet deep at mean low water with a width of 100 feet from the mouth to New Bridge, near Townsend's Wharf, and thence 80 feet wide to the county bridge at Odessa, the estimated cost of the improvement being $39,963. Up to the close of the fiscal year ending June 30, 1891, the sum of $4,963.72 has been expended, giving a greatly increased harbor space at the town of Odessa.

Nothing was done during the past fiscal year.

July 1, 1891, balance unexpended	$36. 28
July 1, 1892, balance unexpended	36. 28
Amount appropriated by act approved July 13, 1892	5, 000. 00
Amount available for fiscal year ending June 30, 1893	5, 036. 28
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	29, 963. 00

(See Appendix H 3.)

4. Smyrna River, Delaware.—This river, formerly called Duck Creek, had, before improvements began in 1879, a minimum depth of 2½ feet within the river and about 4 feet over the bar at the mouth. Navigation was possible only at high tide, and was carried on by one steamer and seven small schooners.

In 1878 a project was made for the improvement of the whole river, including a plan for deepening the channel across the bar at the mouth. By special direction of Congress the improvement of the bar was commenced first, and during the following four years three appropriations, aggregating $10,000, were expended in dredging a channel across this obstruction 100 feet wide and 8 feet deep at mean low water. The dredged channel soon filled up again.

A new project was submitted in 1887 for a 7-foot low-water channel, 60 feet wide inside the river and 100 feet at the bar, the channel at the latter point to be protected on each side by stone jetties. The estimated cost of this project is $90,698.40. The portion of the project relating to dredging has been adopted.

At the close of the fiscal year ending June 30, 1891, the sum of $12,536.35 had been expended in dredging inside the river. At that date a channel had been dredged 40 feet wide and 6½ feet deep at mean low water from Smyrna Landing to Brick Store Wharf, a distance of 3 miles, with the result of opening navigation for vessels drawing 6 feet to the first-named point, which formerly they were not able to reach. The main landing on the river was thus brought about 2 miles nearer the town of Smyrna.

At the beginning of the fiscal year ending June 30, 1892, dredging operations under contract with the National Dredging Company, of Wilmington, Del., were in progress. The contract was completed on August 10, 1891, the proposed channel, 40 feet wide and 6½ feet deep, having been extended farther down the river since July 1, to Eagle Nest Landing, about 2½ miles below Brick Store Wharf. The narrow channel thus far made has been of great benefit to the existing shipping, and has considerably facilitated expeditious and regular transportation, which heretofore was impossible. It is contemplated by the steamboat company to put larger boats on the line after the full projected width and depth in the channel have been made.

July 1, 1891, balance unexpended	$4,697.28
June 30, 1892, amount expended during fiscal year	4,607.61
July 1, 1892, balance unexpended	89.67
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	3,089.67
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	19,365.00

(See Appendix H 4.)

5. *Mispillion Creek, Delaware.*—The entrance to this creek has a mean low-water depth of only 1½ feet. Within the stream the original depth was, before improvements were begun, from 4 to 5 feet. The original project for improvement, which was made in 1879, is for a 6-foot low-water channel, 40 feet wide, from Milford, at the head of navigation, to the mouth. But for a small shoal near the mouth which remains to be dredged, the projected channel is completed, $17,000 having been expended up to June 30, 1889. A report upon a survey of the mouth of the creek embodying a new project was submitted during the past fiscal year (see Appendix H 21).

Amount appropriated by act approved July 13, 1892	$12,000.00
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	14,000.00

(See Appendix H 5.)

6. *Broadkiln River, Delaware.*—In its original condition the depth of water in the river was from 3 to 4 feet at the numerous shoals which impeded navigation. The depth at the entrance was and still is from 1½ to 2 feet at low water.

A project for a 6-foot low-water channel inside the river from Milton to the mouth and for a new entrance across Lewes Cape was submitted in 1871, at an estimated cost of $80,447. This estimate was reduced in 1881 by a revised project to $51,450. At the close of the fiscal year ending June 30, 1891, $35,000 had been expended, and the channel inside the river was completed. After entering, vessels are now no longer detained by the shoals at low tide and proceed directly to their destination. Whilst the results are of great benefit to the existing shipping it is not apparent that the latter has increased to any appreciable extent. Nothing was done during the past fiscal year.

Amount (estimated) required for completion of existing project....... Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	$21,500.00

(See Appendix H 6.)

7. *Inland water way from Chincoteague Bay, Virginia, to Delaware Bay, at or near Lewes, Delaware.*—This improvement is made with the view of forming an inland navigation route, about 75 miles in length, between Chincoteague Bay, Virginia, and Delaware Bay, at or near Lewes, Delaware.

The project adopted in 1886 contemplates an open channel 70 feet wide at the bottom and 6 feet deep below the mean low-water level in the Delaware Breakwater Harbor, beginning in Chincoteague Bay and following approximately deep water in Synepuxent, Isle of Wight, and Assawoman bays; thence across the country for about 4 miles, between Little Assawoman Bay and Indian River Bay, and across the latter into and up Rehoboth Bay; thence from the head of Rehoboth Bay across Lewes and Rehoboth Hundred, for about 8 miles, to Delaware Bay. The originally estimated cost of the improvement was $350,000. A modification of the project was submitted during the past fiscal year to the Chief of Engineers, at the request of the Delaware Congressional delegation, for a reduction in the proposed width of the water way from 70 to 20 feet. The reommendation was approved by the Secretary of War on March 2, 1892.

There are several shoals within the bays named where the present depth of water does not exceed 2½ feet. It is estimated that the amount of commerce created by this improvement, when completed, will be $2,000,000 per annum.

Three appropriations have been made for this work, one of $18,750, and one of $50,000, to be expended between Chincoteague Bay and Indian River Bay, and one of $50,000 to be expended between Chincoteague Bay and Delaware Bay.

Up to June 30, 1891, the sum of $58,585.28 had been expended and a cut 20 feet wide at the base and 4 feet deep had been made connecting the 4-foot depth in Assawoman Bay with that in Indian River Bay. Three temporary wooden bridges had also been constructed across this canal.

During the past fiscal year these bridges were provided with draws and a few shoals at the inlet of lateral drains in the canal were removed. A few small schooners and sloops are now making occasional trips between Ocean View at the northern end of the canal and Chincoteague Island. The depth made in the canal is maintaining itself.

The route for the section of the inland water way between Rehoboth Bay and Delaware Bay was finally located during the past winter. The commissioners appointed by the legislature of the State of Delaware are now engaged in the appraisement and condemnation of the land appropriated for the canal, and it is proposed to begin active operations on this section soon after the title has been obtained.

July 1, 1891, balance unexpended	$60, 164. 72
June 30, 1892, amount expended during fiscal year	9, 347. 59
July 1, 1892, balance unexpended	50, 817. 13
Amount appropriated by act approved July 13, 1892	25, 000. 00
Amount available for fiscal year ending June 30, 1893	75, 817. 13
Amount (estimated) required for completion of existing project	206, 500. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 7.)

8. *Susquehanna River above and below Havre de Grace, Maryland.*—Before improvements were begun in this section of the river the least depth of water over the shoals between Havre de Grace and Spesutia Island was 5 feet at low water. The channel between Watson Island, above Havre de Grace, and the shoal running out from the west shore was narrow and was believed to be one of the causes of ice gorges at and near Port Deposit.

Improvements have been in progress since 1852. The present general project is for a 15-foot low-water channel below Havre de Grace and for the removal of the shoal opposite Watson Island to a depth of 8 feet below mean low water.

The channel below Havre de Grace was dredged the last time in 1885. It has shoaled again. The channel at Watson Island has been widened about 400 feet, but the shoal which was removed has nearly entirely reformed since the discontinuance of work in 1889. At the close of the fiscal year ending June 30, 1891, $158,687.65 had been expended in these improvements.

There were no operations during the fiscal year ending June 30, 1892. A report on the survey of the river in this locality was submitted December 26, 1891, with estimates for a new project (see Appendix H 22).

July 1, 1891, balance unexpended	$4, 202. 35
June 30, 1892, amount expended during fiscal year	107. 66
July 1, 1892, balance unexpended	4, 094. 69
Amount appropriated by act approved July 13, 1892	4, 000. 00
Amount available for fiscal year ending June 30, 1893	8, 094. 69
Amount (estimated) required for annual dredging	20, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 8.)

9. *North East River, Maryland.*—This river is a small tributary of Chesapeake Bay, and joins the latter at the head of the bay, east of the mouth of the Susquehanna River. Its tidal portion is in Cecil County, Md., and is broad but shallow, and about 5 miles long, the town of North East being at the head of navigation. The average rise of the tide is 2¼ feet. The river is obstructed by a bar about three-fourths of a mile below the town. The original depth of water on the bar was 18 inches at low tide.

In 1873 and 1881 a channel was dredged with appropriations aggregating $15,500, from outside the bar to the wharves; the depth made was 6 feet at mean low water. Certain portions of the channel filled in again, reducing the former depth to 4 feet.

The present project for improvement, adopted in 1890, provides for a channel 6 feet deep at low water, 75 feet wide across the bar, and 60 feet wide to Davis's Wharf at North East. The estimated cost is $5,140.

At the close of the fiscal year ending June 30, 1891, $17,806.15 had been expended in the improvement of this river, of which sum $2,306.15 was expended under the present project. On that date a channel existed across the bar 5,700 feet long, 40 feet wide, and 6½ feet deep, ending in deep water at the junction of Stony Run. It was too early then to give any statements what effect the opening of this channel had upon shipping, which has ever been very limited. Nothing was done during the past fiscal year.

July 1, 1891, balance unexpended	$2,393.85
June 30, 1892, amount expended during fiscal year	2,332.22
July 1, 1892, balance unexpended	61.63
Amount appropriated by act approved July 13, 1892	2,640.00
Amount available for fiscal year ending June 30, 1893	2,701.63

(See Appendix H 9.)

10. *Elk River, Maryland.*—This river is a tributary of Chesapeake Bay and is navigable for 17 miles as far as the town of Elkton, in Cecil County, where the tide rises on an average 2½ feet.

Improvements were begun in 1873, when a project was made for a 6-foot low-water channel from 50 to 70 feet wide in the river proper, from the county bridge at Elkton to Cedar Point and in Little Elk River from the junction to Bennett's Wharf, and for 3,300 feet of diking as a partial protection. The project was completed in 1884. The result was a channel 80 feet wide over the bar near Cedar Point and 70 feet wide up to the bridge, with a general depth of 7 feet below mean low water. Before improvements were begun the least depth in the channel was 1¼ feet.

The present project for improvement, proposed in a report on a survey made in 1889, and adopted under an appropriation of $10,000, made September 19, 1890, provides for an 8-foot low-water channel, 100 feet wide, from the county bridge at Scott's Wharf to the clubhouse opposite Cedar Point, a distance of nearly 3 miles. The estimated cost is $24,000.

During the past fiscal year the channel was improved as proposed for a length of 3,800 feet below the county bridge, and a shoal below the mouth of Little Elk River was removed to the required width and depth. The harbor space was thereby greatly increased.

July 1, 1891, balance unexpended	$9,942.18
June 30, 1892, amount expended during fiscal year	8,846.41
July 1, 1892, balance unexpended	1,095.77
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	6,095.77
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	9,000.00

(See Appendix H 10.)

11. *Fairlee Creek, Maryland.*—The original depth at the mouth before improvements were begun was 2 feet at low tide; within the creek it was about 5 feet. Navigation was, and still is, carried on by a few flat-bottomed, so called, lime boats and by one small schooner.

The existing project is for a 7 foot low-water channel, 100 feet wide, from deep water in Chesapeake Bay to a point about 3 miles above the mouth of the creek, the estimated cost being $15,558.

Up to the close of the fiscal year ending June 30, 1891, $10,000 had been expended and the channel, as proposed, from deep water in the bay to the mouth had been completed, and a portion of the channel inside the creek had been dredged to the required depth for a distance of 4,738 feet, but only for a width of 50 feet.

Although the availability of the creek for the purposes of navigation and commerce was measurably increased by the improvement lately made, there are as yet no signs that indicate any increase in the very limited commerce as it now exists.

There were no operations during the fiscal year ending June 30, 1892.

July 1, 1891, balance unexpended	$115.35
June 30, 1892, amount expended during fiscal year	92.88
July 1, 1892, balance unexpended	22.47
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	5,558.00

(See Appendix H 11.)

12. *Chester River, Maryland, from Crumpton to Jones Landing.*—This river is a tidal stream, 40 miles long, forming the boundary line between Kent and Queen Anne counties, Eastern Shore of Maryland, and flows into Chesapeake Bay. It is navigable for 33 miles for vessels drawing 6 feet of water at low tide. The minimum depth of water within the last 7 miles of the river is 3 feet, but the tide rises on an average 2.1 feet at the lower end of this section. Portions of the river situated farther down have previously been improved by the United States.

The project for improvement proposed in a report on a survey made in 1889, and adopted under an appropriation made September 19, 1890, provides for dredging a channel 6 feet deep at mean low water, and 60 feet wide from Crumpton, in Queen Anne County, to a point 1 mile below Millington, in Kent County, at an estimated cost of $12,750. The length of the section to be improved is about 6 miles.

At the close of the fiscal year ending June 30, 1891, preparations had been made for beginning the improvement under the first appropriation and the work had been let. Operations were begun on October 28, 1891, the contract being completed February 8, 1892. The result was that the 4 miles of river between Crumpton and Kirby Landing were cleared of all obstructions, a channel 6 feet deep at low water and 60 feet wide having been dredged through all the existing shoals and bars. The channel is still in good condition, and a number of grain boats have commenced to make regular trips from Kirby Landing.

July 1, 1891, balance unexpended	$4,992.35
June 30, 1892, amount expended during fiscal year	3,088.58
July 1, 1892, balance unexpended	1,903.77
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	4,903.77

Amount (estimated) required for completion of existing project	$4,750.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 12.)

13. Choptank River, Maryland.—Before improvements were begun in 1879 the depth of water between Denton and Greensboro varied from 2 to 8 feet at low water. Navigation, carried on by small sailing vessels, extended only to 3 miles above Denton. Upon the remaining 5 miles to Greensboro all freight had to be transported in scows.

A project for improvement was made in 1880 for an 8-foot low-water channel 75 feet wide, the estimated cost being $79,000. The project was adopted the same year, an appropriation of $5,000 having been made on June 14. During the three following years the channel was dredged to a depth of only 6 and 7 feet, on account of the small appropriations made for the work and the prevailing high prices for dredging. Since 1885 the channel has been dredged to the approved depth of 8 feet, its width being still restricted to 40 feet.

Up to the close of the fiscal year ending June 30, 1891, the sum of $37,513.63 had been expended in dredging, and a continuous channel 40 feet wide now exists between Denton and Greensboro with a depth of 8 feet, except for a certain portion 1¾ miles in length, in which the minimum depth is from 5 to 7 feet. The improvements so far have been of great benefit to the country at Greensboro and below, and during the past five years a regular steamboat line has been in operation between this town and Baltimore.

There were no operations during the past fiscal year. Contract has been made to expend in dredging during the summer of 1892 the $7,500 appropriated September 19, 1890.

July 1, 1891, balance unexpended	$7,486.37
June 30, 1892, amount expended during fiscal year	281.65
July 1, 1892, balance unexpended	7,204.72
July 1, 1892, amount covered by uncompleted contracts	6,500.00
July 1, 1892, balance available	704.72
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	3,704.72
Amount (estimated) required for completion of existing project	20,000.00
Submitted in compliance with requirements sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 13.)

14. Cambridge Harbor, Maryland.—The entrance to this harbor was originally 4½ feet deep at low tide. The average depth in the harbor was about 3 feet; in a few places it was 8 and 9 feet. The bar at the entrance was impassable during strong northwesterly winds for vessels drawing 3 feet of water. The local commerce was carried on by a limited number of sailing vessels of the smallest class and by one steamer of light draft.

Previous to 1871 the citizens of Cambridge had made an effort to increase the availability of the harbor by expending $7,500 in dredging. In that year the improvement of the harbor was begun by the General Government under a project completed in 1879, resulting in a channel 100 feet wide across the bar which was dredged, together with certain portions of the inner harbor, to a depth of 8 feet below mean low water. During the year 1884 this channel was slightly widened. At the close of the fiscal year ending June 30, 1888, $32,500 had been expended by the General Government.

A new project based upon a survey made in 1887 was adopted in 1888, providing for a channel 12 feet deep at low water and 150 feet wide from the Choptank River to the railroad wharf and for dredging the inner harbor below the drawbridge to a depth of 10 feet and above the bridge to a depth of 8 feet below low water, at an estimate cost of $17,736.60. At the close of the fiscal year ending June 30, 1891, the sum of $4,918.72 had been expended in the execution of this project, resulting in a channel 12 feet deep at low water and 88 feet wide across the bar as far as the Maryland Steamboat Company's Wharf, and thence 22 feet wide to the railroad wharf. Vessels drawing 11½ feet of water that formerly could not enter the harbor at all can now come up to this wharf without much difficulty.

There were no operations during the fiscal year ending June 30, 1892, as the expenditure of the appropriation of $5,000 made September 19, 1890, is being delayed by the contemplated construction of a wider draw in the county bridge across the harbor.

July 1, 1891, balance unexpended	$5,081.28
June 30, 1892, amount expended during fiscal year	8.72
July 1, 1892, balance unexpended	5,072.56
Amount appropriated by act approved July 13, 1892	7,737.00
Amount available for fiscal year ending June 30, 1893	12,809.56

(See Appendix H 14.)

15. Wicomico River, Maryland.—Wicomico River flows in a southwesterly direction through Wicomico County, Eastern Shore of Maryland, into Tangier Sound, Chesapeake Bay. Its tidal portion is 23 miles long. Salisbury, the county seat, is at the head of navigation, and the tide rises there about 3 feet. The original depth in the river near Salisbury was 18 inches before the improvement of the river was begun in 1872. Under a project made in that year and completed in 1885, $50,000 was expended, resulting in a channel 7 feet deep at mean low water and from 75 to 100 feet wide at and below Salisbury.

The present project for improvement, necessitated by the increased business of the port, was submitted in a report upon a survey made in 1889 and was adopted in 1890. It provides for a channel 9 feet deep at mean low water, 100 feet in width from near Fruitland wharf to the drawbridge in Salisbury, at an estimated cost of $23,000. The length of the proposed channel is about 3 miles.

The first work under the new project was done during the past fiscal year. A channel about 30 feet wide and of the approved depth, 9 feet, was dredged from Goose Island wharf to the drawbridge in Salisbury, for a distance of 9,250 feet. The increased depth afforded at once great relief to deep-draft vessels during low tides.

July 1, 1891, balance unexpended	$10,914.63
June 30, 1892, amount expended during fiscal year	10,145.67
July 1, 1892, balance unexpended	768.96
Amount appropriated by act approved July 13, 1892	6,500.00
Amount available for fiscal year ending June 30, 1893	7,268.96
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	6,700.00

(See Appendix H 15.)

16. Manokin River, Maryland.—Manokin River is a small tidal tributary of Tangier Sound, Chesapeake Bay, and flows in a southwesterly direction through Somerset County on the Eastern Shore of Maryland. Its length is about 18 miles, the lower 10 miles forming a wide estuary. The main channel is interrupted at the head of the estuary for nearly 3 miles by shallow mud flats, which rendered the upper river almost useless for the purposes of navigation. The average rise and fall of the tide near the obstruction is 2.6 feet.

The project for improvement proposed in a report on a survey made in 1889 and adopted under an appropriation of $7,500 made by act approved September 19, 1890, provides for dredging a channel 6 feet deep at mean low water, and 100 feet wide, from Locust Point to Sharp Point, embracing the section called the "Mud Flats," at an estimated cost of $30,000.

With the appropriation above referred to, a cut was made during the fiscal year ending June 30, 1891, at the section indicated, 13,515 feet long, 30 feet wide, and 5 feet deep at low tide, at an expense of $7,360.12.

There were no operations during the past fiscal year. The dredged cut, which, after being completed, enabled the steamboat plying between Princess Anne and Deal Island to make regular trips, is reported to be in fair condition.

July 1, 1891, balance unexpended	$139.88
June 30, 1892, amount expended during fiscal year	10.80
July 1, 1892, balance unexpended	129.08
Amount appropriated by act approved July 13, 1892	7,500.00
Amount available for fiscal year ending June 30, 1893	7,629.08
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	15,000.00

(See Appendix H 16.)

17. Onancock Harbor, Virginia.—Onancock Harbor or Onancock River, is about 5 miles long and flows through the western portion of Accomac County, Va., into Chesapeake Bay. At the town of Onancock, which is situated at the head of the river, the depth of water was originally 4 feet at low tide. At the mouth of the river, where a bar forms the most serious obstruction, the original depth was 5 feet. The average rise and fall of the tide is about 2 feet.

During the years 1880 and 1881, $8,000 was expended in dredging a channel 100 feet wide across the bar to a depth of 8 feet below mean low water, and in dredging the shoals at Onancock and above Wise Point to a depth of 7 feet. The improvements were of great benefit to the shipping in the river, but the channel at the bar slowly filled up again to nearly its original depth.

The present project for improvement proposed in a report on a survey made in 1889, and adopted under an appropriation of $6,000, made September 19, 1890, provides for dredging a channel 300 feet wide at the outer bar and 200 feet wide at the inner bar, called the "middle ground," both to a depth of 8 feet below mean low water, at an estimated cost of $12,511. The first work under the new project was done during the past fiscal year. A channel was dredged across the outer bar for a width of 150 feet and across the inner bar for a width of 100 feet, both to the required depth of 8 feet. Since then no delays have occurred to vessels wishing to enter at low tides and during northwesterly winds.

July 1, 1891, balance unexpended	$5,970.25
June 30, 1892, amount expended during fiscal year	5,875.44
July 1, 1892, balance unexpended	94.81
Amount appropriated by act approved July 13, 1892	6,511.00
Amount available for fiscal year ending June 30, 1893	6,605.81

(See Appendix H 17.)

18. *Harbor at Cape Charles City, Virginia, and approaches by Chenton (Cherrystone) Inlet.*—The harbor of Cape Charles City is an artificial rectangular basin of about 10 acres area, excavated in the shore of the Chesapeake Bay, about 12 miles north of the cape of the same name. It is in Northampton County, Virginia, and forms the shore terminus of the New York, Philadelphia, and Norfolk Railroad, from which transfers of freight and passengers are made to and from Norfolk, Va. The average rise of the tide is 2.6 feet.

The project for improvement proposed, in a report on a survey made in 1889, provides for dredging the harbor to a depth of 14 feet, and the entrance thereto and the channel in Cherrystone Inlet and across Cherrystone Bar to a depth of 16 feet, below mean low water, the width of the two last-named channels to be 100 and 200 feet, respectively, and for protective works of stone at the entrance to the harbor. The estimated cost of the project is $142,340.

The harbor was originally a small fresh-water pond, and was inclosed with bulkheads by the railroad company and then dredged, together with its new entrance leading into Cherrystone Inlet, to a depth of about 12 feet below mean low water. This depth was, however, not sufficient for the large boats and barges employed of necessity in the increasing traffic; the entrance was also too narrow, and during the prevalence of northerly winds and low tides frequent delays occurred by grounding of vessels at the entrance or in the channel across Cherrystone Bar.

The portion of the project relating to dredging was adopted in 1890, and at the close of the fiscal year ending June 30, 1891, the sum of $21,676.89 had been expended in dredging about one-half of the area of the harbor to 14 feet and in widening the entrance gradually from 50 feet at its shore end to 480 feet at its junction with the channel in Cherrystone Inlet, the depth made being 16 feet, and in removing to the same depth a small shoal in the main channel 1 mile south of the harbor. The difficulties formerly encountered in leaving or entering the harbor have been much lessened.

There were no operations during the past fiscal year. The dredged area within the harbor and in the entrance is shoaling again, according to a survey recently made by the railroad company, and to a greater degree in the entrance than in the harbor. The material is readily swept in from the adjacent shoals on each side of the cut, and will continue to do so unless arrested by artificial works.

July 1, 1891, balance unexpended	$3,323.11
June 30, 1892, amount expended during fiscal year	668.67
July 1, 1892, balance unexpended	2,654.44
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	12,654.44

Amount (estimated) required for completion of existing project	$10,400.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 18.)

19. *Removing sunken vessels or craft obstructing or endangering navigation.*—During the fiscal year ending June 30, 1892, the following wrecks were removed under the provisions of the act of June 14, 1880: The schooner *Harvey W. Anderson*, off Hog Island, Virginia, and schooner *Ann R. Rogers*, off Cobbs Island, Virginia.

(See Appendix H 19.)

EXAMINATIONS AND SURVEYS, MADE IN COMPLIANCE WITH PROVISIONS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, William F. Smith, United States agent, and reports thereon submitted through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division. It is the opinion of Maj. Smith and of the division engineer, based upon the facts and reasons given, that these localities are worthy of improvement. The conclusions of these officers being concurred in by me, Maj. Smith was charged with and has completed their survey and submitted reports thereon. The reports were transmitted to Congress and printed as executive documents of the Fifty-second Congress, first session.

1. *Murderkill River, Delaware.*—The proposed improvement contemplates the formation, by dredging, of a channel 7 feet deep at low water from Frederica to the 7-foot curve in Delaware Bay, 80 feet wide down to the mouth, and 150 feet wide at bottom and 250 feet wide at top from the mouth to the 7-foot curve in the bay; the cut at the mouth to be protected by forming an embankment of the dredged material on each side to a height of at least 2 feet above high spring tides. The cost of this work is estimated at $47,550. Printed as House Ex. Doc. No. 21. (See also Appendix H 20.)

2. *Mispillion River, Delaware, with a view of cutting a canal so as to shorten the distance to the bay and making an outlet in the bay which would furnish deeper water.*—The improvement proposed contemplates dredging a channel 150 feet wide and 6 feet deep at mean low water, extending from the outlet of the river in a southeasterly direction to the 6-foot depth in Delaware Bay, the cut being protected by forming a wall of the dredged material, a stiff blue clay, along its northern side. The cost of this work is estimated at $24,000. Printed as House Ex. Doc. No. 57. (See also Appendix H 21.)

3. *Susquehanna River, above Havre de Grace, Maryland.*—The plan of improvement, proposed with a view to preventing damage by ice gorges in Susquehanna River in the vicinity of Port Deposit and Havre de Grace, Md., contemplates deepening the shoal below the Philadelphia, Wilmington and Baltimore Railroad bridge so as to enlarge the cross section of the river at that point, and constructing eight piers at the Hog Back, above Port Deposit, so as to break up the ice or cause the gorges to form at that point. The estimated cost of this work is as follows:

Dredging	$345,109.05
Construction of eight piers	80,000.00
Total	425,109.05

Col. William P. Craighill, Corps of Engineers, Division Engineer, remarks upon this subject as follows:

> It should be understood, if this work is to be undertaken by the United States, that it is not for the benefit of navigation.
>
> It is an expensive work, both in first cost and in maintenance. The shoals will surely reform and require redredging. It would be interesting to know how much an ice gorge actually costs the town of Port Deposit and its inhabitants. It might be found cheaper to let the gorges come as they do, occasionally, and for the United States to pay the expense entailed each time rather than to incur a heavy expense for works which will not guarantee protection.

Printed as House Ex. Doc. No. 52. (See also Appendix H 22.)

4. *Rock Hall Harbor, Maryland.*—The improvement recommended contemplates dredging a 10-foot low-water channel, 100 feet wide, from the channel in Swan Creek Inlet to the old pier in the harbor, at an esmated cost of $9,513. Printed as House Ex. Doc. No. 56. (See also Appendix H 23.)

IMPROVEMENT OF PATAPSCO RIVER AND CHANNEL TO BALTIMORE, MARYLAND, AND OF JAMES RIVER, VIRGINIA.

Officer in charge, Col. William P. Craighill, Corps of Engineers.

1. *Patapsco River and channel to Baltimore, Maryland.*—The depth of this channel has by successive steps been increased from 17 feet at mean low water to 27 feet, with an average rise of tide of about 18 inches.

The project of improvement first adopted and commenced in October, 1853, had for its object to give a channel 22 feet deep at mean low water, with a width of 150 feet.

Little was done before the late war, but afterwards these dimensions were increased, a depth of 24 feet at mean low water being determined upon, with a width of channel ranging from 250 to 400 feet.

This channel was completed in 1874, important changes of position having been given to a portion of it, by which the distance was materially lessened and the expense of maintenance decreased.

The object of the improvement was to permit the approach to Baltimore, at mean low water, of vessels drawing from 22½ to 23 feet, and at ordinary high water of vessels drawing 24 and 24½ feet. Later the project had in view a depth of 27 feet at mean low water, with a width of 600 feet, to allow the entrance and departure of the largest vessels.

Operations were brought to a close in August, 1889, for want of money and were not resumed in the year ending June 30, 1890. The channel throughout had then been excavated to 27 feet at low water. The Craighill Channel below the cut off, the Cut-off Channel, and the Brewerton above the cut-off had been excavated to 400 feet width. The Fort McHenry division was generally 250 feet in width, except at the upper end, where it was 500. All the angles were much wider, the object being to facilitate the movement of large ships at these turns. The portions of the Brewerton below the cut-off and of the Craighill above it have not been dredged for years, and are not now considered a part of the channel under improvement by the United States. Their width is about 250 feet and the depth 24 feet.

Up to June 30, 1891, the United States had expended $2,561,010.48. The city of Baltimore and the State of Maryland, chiefly the former, have also contributed to the same object more than $500,000. The expenditure up to June 30, 1892, by the United States was $2,932,517.01.

The river and harbor act of September 19, 1890, appropriated

$340,000, and the sundry civil act of March 3, 1891, an additional sum of $151,200. The former contained the following important proviso:

> *Provided*, That such contracts as may be desirable may be entered into by the Secretary of War for the completion of the existing project, or any part of same, to be paid for as appropriations may from time to time be made by law.

Operations in carrying out the approved project were resumed as soon as possible after September, 1890, and have been vigorously in progress since, under a contract with the American Dredging Company.

The work was suspended from January 20, 1892, to March 22, owing to inclement weather, and advantage was taken of this opportunity to make needed repairs to the plant. Extensive repairs of the United States tug *Robert Leslie* have also been found necessary. She has been nearly forty years in service.

At the close of the fiscal year the work is so well advanced that the completion of the channel to a width of 600 feet and a depth of 27 feet at mean low water throughout the whole length is expected in the calendar year 1892, although not required by the contract until the middle of 1893.

As the divisions of the channel are completed, a resurvey is made to insure accuracy of finish before final payment to the contractor. Under the contract the large amount of nearly 5,000,000 yards of material has been removed. About 1,000,000 more remains to be excavated to make the channel 600 feet wide.

Of course this channel will require repairs from time to time, like all artificial highways. The latest experience and a restudy of the conditions of the case confirm the opinion and estimate made some years ago that the maintenance of the channel after completion will require the annual expenditure of $50,000. This is, however, a small sum when contrasted with the great gain to Baltimore and her dependent interests, as well as in revenue to the United States Treasury, by the increase of the depth from 17 to 27 feet at low water, which means the introduction of many lines of deep ocean steamers to European and other foreign and domestic ports within the past twenty years, whereas there were none before of any importance.

The following remarks in regard to the commerce of Baltimore are taken from the annual statement of the collector of the port:

> The tonnage movement at this port for the fiscal year ending June 30, 1892, shows a most gratifying and encouraging increase, both as to the number of vessels arriving and departing and in the increased carrying capacity, the latter being entirely due to the widening and deepening of the channel approaches to our harbor, which now enable vessels drawing 27 and 28 feet of water to pass up and down with perfect ease and safety.
>
> * * * * * * *
>
> The president of the Association of Maryland Pilots informs me that the average draft of water of the vessels in the foreign trade is 14 feet for sailing and 21 feet for steam; 34 steam vessels drawing 25 to 28 feet have passed through the channel during the past year.
>
> The facilities for landing and transporting immigrants have been increased and are now unsurpassed.
>
> * * * * * * *
>
> The foreign tonnage movement shows an increase of 55 per cent.
>
> * * * * * * *
>
> In the matter of exports a most desirable increase is shown to the extent of $34,000,000, notably in wheat, corn, flour, all of which have gained from 100 to 200 per cent. Rosin, dried apples, oil-cake, beef, tallow, lard, pork, cotton-seed oil, show a most decided increase, while there is a perceptible increase running through 80 per cent of the entire merchandise exported.

July 1, 1891, balance unexpended		$437, 816. 68
June 30, 1892, amount expended during fiscal year		371, 506. 53
July 1, 1892, balance unexpended		66, 310. 15
July 1, 1892, outstanding liabilities	$1, 500. 00	
July 1, 1892, amount covered by uncompleted contracts	205, 834. 03	
		207, 334. 03
Amount appropriated by act approved August 5, 1892		208, 000. 00

(See Appendix I 1.)

2. *James River, Virginia.*—When the improvement of the James River was regularly undertaken by the Government the navigation was obstructed by sunken vessels, by remains of military bridges, and by other obstructions put into the river during the late war to prevent the national fleets from approaching too close to Richmond.

There were also other natural obstructions. Rockett Reef and Richmond Bar had only 7 feet of water at mean low tide. From Warwick Bar to Richmond the channel was crooked and obstructed by dangerous rocks and ledges, the Dutch Gap cut-off was not then open, and the river was in a poor condition as regards its availability for commercial purposes.

The original project of improvement was to secure a depth of 18 feet at full tide (corresponding to about 15 feet at low tide) to Richmond, with a channel width of 180 feet. This project had reached an advanced state of progress when Congress, by act approved July 5, 1884, adopted another looking to 22 feet at mean low tide from the sea to Richmond, the width to be 400 feet from the sea to City Point, 300 from thence to Drewry Bluff, and 200 feet from thence to Richmond.

The total amount expended on this river by the United States up to June 30, 1891, was $1,221,505.56, which includes the sum of $490,621.01 expended since the new project was entered upon to give a depth of 22 feet at mean low water. The condition of the river June 30, 1891, was as follows:

The available draft from the sea to Warwick Bar, which is 5 miles from Richmond, was 19½ feet at high water; from Warwick Bar to Goodes Rocks, 17 feet; over Goodes Rocks, 16½ feet, Goodes Rocks to Chesapeake and Ohio wharves, near Richmond, 18 feet, except a space about 250 feet long at Goodes Rocks, where there was an available draft of but 15½ feet.

The amount expended in the year ending June 30, 1892, has been $98,902.63.

The principal operations of the year are shown by the following table:

Locality.	Sand, gravel, and clay.	Decomposed rock.	Solid rock and bowlders.
	Cubic yards.	*Cubic yards.*	*Cubic yards.*
City limits to Stearns Dike	....	10, 620. 5	162
Stearns Dike to Goodes Rocks	....	5, 192. 9	40. 3
Goodes Rocks	....	4, 244. 9	5, 044. 8
Richmond Bar	9, 342. 8	....	722. 8
Randolph Flats	34, 018. 6	....	163. 8
Kingsland Reach	44, 918. 8	....	132
Dutch Gap	13, 545. 4	....	....
Total	101, 825. 6	20, 058. 3	6, 265. 7

In addition, there has been constructed a transfer slip and railway to facilitate the distribution of material removed from the river.

It consists of a railway of standard gauge, about 1,300 feet long, and 8 feet above high tide, built on a pile causeway with an incline to the river, on a grade of about 2 per cent, where it will connect with a barge rising and falling with the tide. To this scows with loaded cars can be brought and thence taken by a locomotive to the dumping ground.

The railway was built under a contract with Mr. C. D. Langhorne, between November, 1891, and April, 1892. All the materials, including the rails and fastenings, were furnished by the contractor, and the whole work is strictly up to requirement.

The barge, or caisson, was built under a contract with Messrs. H. T. Morrison & Co., of Petersburg, Va., and is also in every respect according to contract.

The locomotive, a second-hand tank engine, weighing, with fuel and water, 36,250 pounds, which had been put in good order before its purchase, was furnished by the Tredegar Company, who also furnished a model iron dumping car.

About twenty dumping cars will be needed to keep two ordinary dredges supplied.

Twelve wing dams have also been built at Wilton, varying in length from 50 to 250 feet. Extensive surveys and tidal observations have been made.

No very heavy freshets have occurred. The following are the most important rises, the heights below being above low tide:

	Feet.
August 25, 1891	8.3
January 16, 1892	13.5
January 21, 1892	11.6
March 1, 1892	7.8
March 10, 1892	8.7
April 24, 1892	9.4

The completion of the work in Kingsland Reach and the further removal of the slide of 1889 in Dutch Gap have been of benefit to navigation. The depths of channels elsewhere have generally been maintained with some improvement due to contraction and dredging. The work done in the rocky bottom for 2 or 3 miles below Richmond has been a further progress toward a wider and deeper channel there, but no improvement in available depth from the sea to the city can be reported from the last year, which was 16½ feet at full tide. The surveys of 1890 showed some shoaling from 1880 at Goose Hill Flats and Curles Neck, which reduce the available depth from the sea to Warwick Bar, then reported as 19 feet, to 18.5 feet at full tide.

The present depths of the river at mean low tide, compared with those of 1870 in a channel not less than 80 feet wide are as follows:

	1870.	1892.
	Feet.	*Feet.*
From the city to Richmond Bar	7	13.8
Over Richmond Bar and Randolph Flats	7	15
From Randolph Flats over Warwick Bar	12.4	15.4
From Warwick Bar to City Point (least in Trents Reach)	7	*15.5
From City Point to the sea	14.8	17

* Trents Reach is now avoided by Dutch Gap Cut-off.

When the proposed improvement is completed an annual expenditure of $20,000 will be necessary for the maintenance of the channel.

July 1, 1891, balance unexpended		$142,957.65
June 30, 1892, amount expended during fiscal year		98,902.63
July 1, 1892, balance unexpended		44,055.02
July 1, 1892, outstanding liabilities	$2,000.00	
July 1, 1892, amount covered by uncompleted contracts	33,087.44	
		35,087.44
July 1, 1892, balance available		8,967.58
Amount appropriated by act approved July 13, 1892		200,000.00
Amount available for fiscal year ending June 30, 1893		208,967.58
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		3,536,070.45

(See Appendix I 2.)

IMPROVEMENT OF POTOMAC RIVER AND ITS TRIBUTARIES, OF HARBOR AT BRETON BAY, MARYLAND, AND OF CERTAIN RIVERS ON WESTERN SHORE OF CHESAPEAKE BAY, MARYLAND AND VIRGINIA.

Officers in charge, Lieut. Col. Peter C. Hains, Corps of Engineers, to November 23, 1891; Maj. Lewis C. Overman, Corps of Engineers, November 23 to December 7, 1891; Capt. Thomas Turtle, Corps of Engineers, December 7, 1891, to January 25, 1892, and,Maj. Charles E. L. B. Davis, Corps of Engineers, since January 25, 1892 with Lieut. George A. Zinn, Corps of Engineers, under their immediate orders; division engineer since January 5, 1892, Col. William P. Craighill, Corps of Engineers.

1. *Potomac River at Washington, District of Columbia.*—Before the commencement of this improvement the channel to Georgetown, D. C., was narrow and crooked, and had not sufficient depth to meet the needs of commerce. Vessels drawing 16 feet frequently grounded at high tide above Long Bridge, and frequent dredging was necessary to maintain even this depth. The channel was of insufficient width, as the appropriations for dredging were too small to provide for more than a narrow cut through the bar. The Washington channel was narrow and shoal and inadequate to the wants of commerce. Extensive mud flats existed along the city front from Observatory Hill to a point opposite the arsenal. Below Long Bridge these flats were separated from the city front by the Washington Channel. The greater portion of these flats was exposed at low tide and covered at high tide by water polluted by the sewage of the city. At the foot of Seventeenth street NW. a large sewer discharged directly upon the flats. These conditions rendered a portion of the city almost uninhabitble.

By act passed August 2, 1882, Congress adopted a project which has for its object the improvement of the navigaion of the river by widening and deepening its channels, the reclamation or filling of the marshes on the city front by depositing on them the materal dredged from the channels, and the establishment of harbor lines beyond which no wharves or obstructions should be built. The project provides in detail for such depth of channels as will accommodate the largest vessels that can reach Arsenal Point, with such depth at the wharves as will allow vessels to receive full cargoes without grounding at low water; for filling the flats above Long Bridge to a height of 3 feet above the flood line of 1877, and the middle part of the flats below Long Bridge to the same height, but sloping each way to a height of 6 feet above low tide at the margin of the fill; that in order to purify the water in the Washington Channel, which will be cut off at its upper end from the Virginia or main channel, a tidal reservoir or basin be established above Long Bridge, to be filled with water from the Virginia Channel on the flood tide and discharged into the Washington Channel on the ebb.

The plan also contemplates the rebuilding of Long Bridge, with longer spans and fewer piers, during the progress of the work, and the interception of all sewage now discharged into the Washington Channel and its conveyance to James Creek, but neither the reconstruction of the bridge nor the building of the intercepting sewer were included in the estimate of the cost of the improvement.

The estimated cost of the improvement is $2,716,365.

Appropriations have been made as follows:

Act of—	
August 2, 1882	$400,000
July 5, 1884	500,000
August 5, 1886	375,000
August 11, 1888	300,000
September 19, 1890	280,000
	1,855,000

Twenty thousand dollars of the appropriation of September 19, 1890, was made available for dredging in the Anacostia River, which leaves the aggregate appropriations for the Potomac proper $1,835,000.

Up to the close of the fiscal year 1890 the expenditures aggregated $1,626,821.37, and the following work had been accomplished: The Virginia Channel above Long Bridge had been deepened to 20 feet at low tide for a width of from 400 to 550 feet, a part of which has since filled up and been redredged. The same channel below Long Bridge had been dredged to a depth of 20 feet and a width of about 350 feet. This part of the Virginia Channel has maintained itself to the full depth originally dredged or has deepened. The Washington Channel has been dredged to a depth of 20 feet for a width of 350 feet throughout its entire length, and to a depth of 12 feet from the 20-foot channel nearly to the easterly margin of the fill, from the lower end of the reclaimed area up as far as the Seventh Street Wharf. This channel has for the most part maintained itself, though some filling occurred during the freshet of June, 1889. The junction of the Virginia and Washington channels had been dredged to depths of 20 feet, 15 feet, and 12 feet. The greater part of the tidal reservoir had been dredged to a depth of 8 feet. All the material dredged from the river had been deposited on the flats, and of the 12,000,000 cubic yards estimated to be required about 8,566,000 had been deposited. The entire area of the flats, about 621 acres, had been outlined, and practically the entire area to be reclaimed had been raised above overflow at ordinary high tide.

The riprap foundation for the sea wall had been put in place around the entire river front of the reclaimed area and the margin of the tidal reservoir. The construction of the sea wall for the protection of the margin of the fill from erosion by waves and the action of the tidal currents had been commenced and 5,100 linear feet of wall constructed. The construction of a dike on the westerly side of the Virginia Channel above Long Bridge, with a view to reducing the deposit at that locality, was in progress. The outlet gates of the tidal reservoir at the head of the Washington Channel had been completed, with the exception of the coping.

The expenditures during the fiscal year ending June 30, 1892, were $171,120.

The construction of the sea wall was continued. The greater part of the wall on the Virginia Channel front above the Long Bridge and about two-thirds of that on the Washington Channel front below the Long Bridge were completed.

A new channel, 1,200 feet wide and 20 feet deep, was dredged by contract through the bar in the Virginia channel above the Long Bridge.

Dredging to 12-foot depth in the Washington channel between the 20-foot channel and the reclaimed area below the Long Bridge was continued until February 1, 1892, when a part of the contractors' plant failed, necessitating a suspension of work. The contractors have thus far failed to resume operations.

The coping of the reservoir outlet has been laid.

Anacostia River.—Under the provisions of the river and harbor act of September 19, 1890, which made $20,000 of the $280,000 appropriated for improving the Potomac River available for the Anacostia River, dredging operations have been in progress, and the channel has been widened and dredged to 20 feet in depth at two localities. The excavated material was deposited on the flats.

Long Bridge.—The northerly end of the Long Bridge across the Washington channel has been reconstructed by the Baltimore and Potomac Railroad Company on plans approved by the Secretary of War, the work being as yet incomplete, owing to the settlement of the abutments. Reference is made in the report of the officer in local charge to the necessity of rebuilding Long Bridge. In the event of a freshet occurring when the Potomac River is full of ice, great damage is to be expected. The piers of the bridge are of such faulty construction that an ice gorge would be probable, which would cause the water to back up and overflow portions of the city front, and through the sewers above the bridge such portions of the lower parts of the city as may be drained by them. Great damage was done by the freshet of June, 1889, but greater damage may occur from a freshet of lesser magnitude if accompanied by an ice gorge.

July 1, 1891, balance unexpended		$228,178.63
June 30, 1892, amount expended during fiscal year		171,120.00
July 1, 1892, balance unexpended		57,058.63
July 1, 1892, outstanding liabilities	$703.00	
July 1, 1892, amount covered by uncompleted contracts	41,183.00	
		41,886.00
July 1, 1892, balance available		15,172.63
Amount appropriated by act approved July 13, 1892		200,000.00
Amount available for fiscal year ending June 30, 1893		215,172.63
Amount (estimated) required for completion of existing project		681,365.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix J 1.)

2. *Potomac River at Mount Vernon, Virginia.*—Before this improve-

ment was commenced the ruling depth over the wide flat between the main channel of the Potomac River and the wharf at Mount Vernon was but 4 feet at low tide. The original project, adopted in 1879, was for a channel 150 feet wide and from 6 to 7 feet deep, with a turning basin at the wharf of 150 feet radius. This project was amended in 1888 so as to provide for a channel 200 feet wide and a turning basin of 200 feet radius. On June 30, 1890, $14,500 had been expended and the channel was about 140 feet wide between the 6-foot curves, and from 60 to 100 feet wide between the 9-foot curves, the depth here varying from 9 to 12 feet. The turning basin was 360 feet wide, but was incomplete. The act of September 19, 1890, provided for the completion of the improvement, and operations have been conducted with this end in view.

The channel has been dredged to a width of 155 feet, with a depth of from 8 to 10 feet, and the turning basin completed, the radius being 180 feet. The officer in charge regards the present dimensions of the channel as sufficient for navigation, and no further appropriations are recommended.

July 1, 1891, balance unexpended	$502.86
June 30, 1892, amount expended during fiscal year	502.86

(See Appendix J 2.)

3. *Occoquan Creek, Virginia.*—Occoquan Creek is a tributary of the Potomac River, which it enters about 25 miles below Washington, D. C. Navigation was obstructed by four bars, which were improved between 1873 and 1880 by the expenditure of four appropriations, aggregating $25,000, giving a navigable depth of about 6 feet to Occoquan, the head of navigation, 4 miles above the mouth. In compliance with the provisions of the river and harbor act of August 11, 1888, a new survey was made in 1889, and the condition of the several bars found as follows:

Lower Mud, about 3.5 miles below Occoquan. This bar is about 4,000 feet long and had a ruling depth of about 3 feet. The former dredged channel had filled in.

Upper Mud, about 2.25 miles below Occoquan. The channel dredged in 1874–'75 was found to have maintained its original dimensions, being about 50 feet wide and from 5 to 6 feet deep.

Sand Bar, about one-half mile below Occoquan. The former dredged channel had filled in, the least depth being 4.2 feet.

Occoquan Bar, a short bar opposite Occoquan. The channel dredged here had filled in, and the least depth was 4 feet.

The project for the new improvement comprises the dredging of channels 6 feet deep and from 100 to 150 feet wide through the bars, with the construction of such dikes as may be required to maintain the depth secured by dredging. The first appropriation for the new work was made September 19, 1890. At the close of the fiscal year ending June 30, 1891, $1,605.01 had been expended. The dredging of a channel 6 feet deep and 100 feet wide through the lower bar was then in progress, the condition of the work as regards facility of navigation being, with this exception, substantially the same as at the time of the survey of 1889.

During the fiscal year ending June 30, 1892, the channel through the lower mud has been completed, the depth being 6 feet and the width from 100 to 150 feet, and a channel from 70 to 100 feet wide and 8 feet deep has been dredged through Occoquan Bar. At the last-named bar the depth was made 8 feet to anticipate probable shoaling from freshets, pending the construction of a dike proposed to be built under future appropriations. The bars thus improved were the most serious obstructions, and the work done has afforded material relief to navigation.

July 1, 1891, balance unexpended	$8,394.99
June 30, 1892, amount expended during fiscal year	8,188.98
July 1, 1892, balance unexpended	206.01
July 1, 1892, outstanding liabilities	8.00
July 1, 1892, balance available	198.01
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,198.01
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	30,000.00

(See Appendix J 3.)

4. *Aquia Creek, Virginia.*—Aquia Creek is a tributary of the Potomac River, which it enters about 41 miles below Washington, D. C. The stream is about 7 miles long, and in 1872 its navigation was chiefly obstructed by shoals between the mouth and the "Narrows," 4.5 miles above. Here the creek takes the character of a wide bay, from 1,000 to 6,000 feet wide, while the depths of water ranged from 2 to 4 feet over an almost continuous shoal of soft mud. Above the "Narrows" the creek is from 60 to 200 feet wide, with a depth of from 2 to 17 feet, the shoaler portions being near the head of navigation. The stream is crossed by a bridge of the Richmond, Fredericksburg and Potomac Railroad about 3 miles above the mouth, the draw of the bridge being but 28 feet wide.

From 1872 to 1878 appropriations amounting to $10,000 were made by Congress, and the navigation improved by dredging a channel from 40 to 50 feet wide and from 4 to 5 feet deep through the shoaler parts of the creek, chiefly above the railroad bridge.

A new survey of the creek was provided for in the river and harbor act of August 11, 1888, and was made in 1889. The channel dredged from 1872 to 1878 was found to have maintained its dimensions between the railroad bridge and the "Narrows," but at other places it had filled in. The general depth of water in the creek remained substantially as in 1872. Estimates for improving the navigation were submitted January 18, 1890, and an appropriation of $10,000 made by the river and harbor act of September 19, 1890.

The project for the improvement, approved December 4, 1890, proposes a channel 80 feet wide and 6 feet deep, dredged through the shoals where less than 6 feet is found between the mouth of the creek and the "Narrows."

At the close of the fiscal year ending June 30, 1891, $500 had been expended. A channel 80 feet wide and 6 feet deep had then been dredged from Thorny Point, at the lower end of the shoal, for a distance of about 2,670 feet toward the railroad bridge.

During the fiscal year ending June 30, 1892, the channel was completed up to the railroad bridge, a distance of 12,280 feet from the point of commencement, the full dimensions required by the project—80 feet in width and 6 feet in depth—having been secured. The amount expended during the fiscal year ending June 30, 1892, was $8,889.05.

July 1, 1891, balance unexpended	$9,500.00
June 30, 1892, amount expended during fiscal year	8,889.05
July 1, 1892, balance unexpended	610.95
July 1, 1892, outstanding liabilities	115.00
July 1, 1892, balance available	495.95
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,495.95
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	25,000.00

(See Appendix J 4.)

5. *Harbor at Breton Bay, Leonardtoun, Maryland.*—The navigation of the head of Breton Bay was obstructed in 1874 by a shoal extending from the 9-foot curve in the bay to Leonardtown, a distance of about 1 mile, the least depth on the shoal being 5 feet at low tide. The original project, adopted in 1878, contemplated dredging a channel 150 feet wide and 9 feet deep through the shoal with a suitable turning basin at the wharf. In 1885 the project was amended to provide for a channel 200 feet wide and 10 feet deep, with a turning basin 400 feet wide by 800 feet long. In 1890 the original project was resumed, as this appeared to be sufficient for the navigation of the bay. At the close of the fiscal year ending June 30, 1890, $32,500 had been expended. The condition of the improvement at the close of the last preceding dredging operations (in March, 1889) was as follows: The basin at the Leonardtown wharf was 645 feet long by 370 feet wide. From the lower end of the basin the channel was 150 feet wide for a distance of 1,870 feet, and for a further distance of 1,380 feet around the turn at Buzzard Point the width varied from 185 to 280 feet. The depth varied from 8.5 to 14.6 feet. The channel between Buzzard Point and the 9-foot curve in Breton Bay had not been dredged. At the close of the fiscal year ending June 30, 1891, $33,017.79 had been expended, and the dredging needed to complete the project was in progress.

During the fiscal year ending June 30, 1892, the channel was completed from the 9-foot curve in Breton Bay to the Leonardtown wharf, in accordance with the original project, which was resumed in 1890. The channel is 9 feet deep and 150 wide, except at the turn at Buzzard Point, where the width was increased to 320 feet to facilitate the turning of steamers. The turning basin at the Leonardtown wharf is 600 feet long and 370 feet wide. No further work is required by navigation at present, and no further appropriations are recommended.

July 1, 1891, balance unexpended	$4,482.21
June 30, 1892, amount expended during fiscal year	4,417.21
July 1, 1892, balance unexpended	65.00
July 1, 1892, outstanding liabilities	65.00

(See Appendix J 5.)

6. *Nomini Creek, Virginia.*—This stream is an important tributary of the Potomac, which it enters about 82 miles below Washington, D. C.

Navigation was obstructed in 1872 by a bar of sand and oyster shells at its mouth, over which but 3 feet could be carried at low tide, and the dangers and difficulties of passing the bar were further increased by a rapid current and cross tides. After passing the bar 8 feet can be carried to Nomini Ferry, about 4 miles above the mouth.

The original project for the improvement, adopted in 1873, provided for dredging a channel 100 feet wide and 9 feet deep through the bar. The project was modified in 1879 by increasing the width to 150 feet, and again in 1885 by increasing the width to 200 feet. In 1890 a further modification was made, proposing the construction of two jetties parallel to the outer channel, retaining the width of dredging at 150 feet. The total cost of this modified project was placed at $72,500. At the close of work in 1883 a channel about 100 feet wide and 9 feet deep had been dredged through the bar. During the suspension of work from 1883 to 1889 the cut was reduced in depth and width by deposits of sand. In 1889 the outer channel was widened and redredged on the westerly side for a width of 94 feet and a length of 1,470 feet, the depths being from 8.9 to 13.8 feet.

During the fiscal year ending June 30, 1891, the channel at and outside of White Point was dredged, the width attained being from 130 to 150 feet, and the depth 9 feet. A riprap dike was built inside White Point to check the cross tidal current. Up to June 30, 1891, $39,947.89 had been expended.

During the fiscal year ending June 30, 1892, no work was done, the funds on hand not being sufficient for the prosecution of active operations.

July 1, 1891, balance unexpended	$2, 552. 11
June 30, 1892, amount expended during fiscal year	2, 263. 87
July 1, 1892, balance unexpended	288. 24
Amount appropriated by act approved July 13, 1892	10, 000. 00
Amount available for fiscal year ending June 30, 1893	10, 288. 24
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	20, 000. 00

(See Appendix J 6.)

7. *Patuxent River, Maryland.*—The present head of navigation on the Patuxent River is Bristol, Md., about 46 miles above the mouth. Prior to the commencement of the improvement navigation below Bristol was obstructed by two mud bars (1) Swann Point Bar, about 43 miles above the mouth, having a least depth of 7.8 feet, and (2) Bristol Bar, at Bristol, having least depths in front of the two wharves of 7.6 and 4.2 feet. Two other bars below, viz, Pope Shoal (24 miles above the mouth) and Warren Reach Bar (34 miles above the mouth), were mentioned in the report of the preliminary examination as worthy of survey, but they offer no obstruction to the present standard of navigation.

The original project was adopted in 1888, and contemplated dredging a cut, 200 feet wide and from 12 to 13 feet deep, through Swann Point Bar and Bristol Bar, so as to secure a permanent channel about 100 feet wide and 12 feet deep at low tide. This project was modified in 1890 so as to provide for a channel 120 feet wide and 12 feet deep (then already dredged) at Bristol Bar and a channel about 100 feet wide and 9 feet deep at Swann Point Bar, these last-named dimensions being regarded as sufficient for the present and immediately prospective demands of commerce.

At the close of the fiscal year ending June 30, 1891, $9,816.66 had been expended. A channel, 120 feet wide, 12 feet deep, and 794 feet long, had been dredged at Bristol Bar, and a channel, 9 feet deep, about 100 feet wide, and about 2,250 feet long, through Swann Point Bar.

This work completes the existing project, unless it should appear from future examinations that works of contraction are needed to maintain the channel at Swann Point Bar. At the present time no further appropriations are recommended.

July 1, 1891, balance unexpended	$1,184.84
June 30, 1892, amount expended during fiscal year	263.97
July 1, 1892, balance unexpended	920.87

(See Appendix J 7.)

8. *Rappahannock River, Virginia.*—The obstructions to navigation of the Rappahannock River before improvement were 9 bars between Tappahannock, 41 miles above the mouth, and Fredericksburg, 106 miles above the mouth, over which the ruling depths were from 4 to 10.5 feet. The chief obstructions were in the 12.5 miles of river below Fredericksburg, where 7 of the bars are found. Of these bars, Fredericksburg Bar, with a least depth of 4 feet, and Spottswood Bar, 4 miles below Fredericksburg, with a least depth of 6 feet, caused the most delay to steamboats and vessels.

The original project, adopted in 1871, proposed a channel, 10 feet deep and 100 feet wide, through all the bars. This was modified in 1879 by increasing the dimensions of the channel between Port Royal and Tappahannock to 15 feet in depth and 200 feet in width to accommodate the larger class of vessels.

Up to June 30, 1891, $111,786.24 had been expended, and depths of from 8 to 9.5 feet secured through the bars between Fredericksburg and Port Royal by dredging and the construction of dikes. Wrecks and snags obstructing navigation had also been removed. During the fiscal year ending June 30, 1892, $11,193.24 has been expended. A new plant for building and repairing dikes and for snagging on the Rappahannock, Mattaponi, and Pamunkey rivers has been completed. Channels 10 feet deep and from 40 to 80 feet wide were dredged through portions of Fredericksburg bar for the relief of steamboat navigation. A sunken scow was also removed at this bar. As each recurring freshet brings additional deposits of sand and silt into the river, the officer in charge recommends an annual appropriation of $7,500 for the maintenance of the improvement.

July 1, 1891, balance unexpended	$14,162.83
June 30, 1892, amount expended during fiscal year	11,193.24
July 1, 1892, balance unexpended	2,969.59
July 1, 1892, outstanding liabilities	119.00
July 1, 1892, balance available	2,850.59
Amount appropriated by act approved July 13, 1892	20,000.00
Amount available for fiscal year ending June 30, 1893	22,850.59
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	144,000.00

(See Appendix J 8.)

9. *Urbana Creek, Virginia.*—Urbana Creek is a tributary of the Rappahannock River, which it enters 16 miles above the mouth. Before improvement navigation was obstructed by a bar outside the mouth, over which but 6.5 feet could be carried, and a shoal within the creek having a least depth of 7 feet.

The original project adopted in 1879 provided for dredging a channel 150 feet wide and 10 feet deep through the outer bar. This project was extended in 1883 so as to include dredging to 10 feet through a shoal within the creek near the town of Urbana.

Up to the close of the fiscal year ending June 30, 1890, $18,500 had been expended. The channel through the outer bar had been dredged to a depth of 10 feet and a width of 140 feet, but owing to the action of storms the width had decreased from sand filling to 90 feet. A channel had also been dredged through the shoal within the creek from 80 to 170 feet wide and 10 feet deep, and dikes and jetties had been built along the sand spit to check the movement of sand, which tends to close the natural channel at the end of the spit.

In the river and harbor act approved September 19, 1890, an appropriation of $3,000 was made for continuing the improvement. Under this appropriation the natural channel at the mouth of the creek was widened 70 feet by dredging off the end of the sand spit. The depth made was 10 feet at low tide.

Up to the close of the fiscal year ending June 30, 1892, there had been expended of this appropriation $1,859.04.

July 1, 1891, balance unexpended	$3,000.00
June 30, 1892, amount expended during fiscal year	1,859.04
July 1, 1892, balance unexpended	1,140.96
July 1, 1892, outstanding liabilities	175.00
July 1, 1892, balance available	965.96
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	3,965.96
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	10,080.00

(See Appendix J 9.)

10. York River, Virginia.—The Pamunkey and Mattaponi rivers unite at West Point, Va., to form the York River, which is 41 miles in length and empties into Chesapeake Bay about 16 miles above Old Point, Va. Prior to the commencement of the improvement navigation was obstructed by Potopotank Bar, 9 miles below West Point, on which the ruling depth was 18.5 feet; by West Point Bar, extending about 2 miles below West Point and having a ruling depth of 15.5 feet; and by shoal water in front of the West Point wharves, at the mouth of the Pamunkey.

The original project provided for a channel 22 feet deep and 200 feet wide through these bars, with an increased width at the wharves. In 1884 the proposed channel width was increased to 400 feet, and in 1887 the project was amended so as to include the construction of a dike along the flats on the right of the channel, to contract the water way, and maintain the depth dredged, which had decreased from continued silting.

Up to the close of the fiscal year ending June 30, 1891, $129,910.17 had been expended in the following work: A channel 105 feet wide and 22 feet deep was dredged in 1880–'81 through Potopotank Bar, which had, however, shoaled in 1890 to from 20.8 to 21.7 feet. A channel 22 feet deep and from 161 to 257 feet wide, with a center cut 24 feet deep and 40 feet wide, had been dredged at West Point Bar below the wharves, but this channel had shoaled to such an extent that the ruling depth in June, 1891, was but 18 feet.

On June 30, 1891, dredging was in progress by contract at West

Point Bar, under the appropriation of $30,000 made September 19, 1890. At the first-mentioned date a cut 80 feet wide and 22 feet deep had been made in front of the West Point wharves, the length of the cut being about 2,700 feet. During the fiscal year ending June 30, 1892, these dredging operations were continued, and the channel in front of the wharves widened to 160 feet. The lower end of the channel, where shoaling to 18-foot depth had occurred, was then redredged for a length of about 3,300 feet to a depth of 22 feet and a width of 160 feet, thereby affording material relief to navigation.

Great difficulty was experienced in finding suitable dumping grounds on the York River. The flats on either side of the channel are largely occupied by oyster beds whose owners object to the dumping of material or the construction of dikes.

July 1, 1891, balance unexpended	$28,879.83
June 30, 1892, amount expended during fiscal year	16,054.01
July 1, 1892, balance unexpended	12,825.82
Amount appropriated by act approved July 13, 1892	35,000.00
Amount available for fiscal year ending June 30, 1893	47,825.82
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	115,050.00

(See Appendix J 10.)

11. Mattaponi River, Virginia.—The Mattaponi River is navigable for small steamers from its mouth at West Point, Va., to Ayletts, Va., a distance of about 52 miles, and can be made navigable for barges for about 26 miles above Ayletts to Munday Bridge. The obstructions to 5.5-foot navigation are five bars below Ayletts, having ruling depths of from 2.5 to 3.6 feet, and wrecks, snags, logs, and overhanging trees. There were eight bars reported above Ayletts, but no improvement of them is proposed.

The approved project adopted in 1880 provides for a channel 40 feet wide and 5.5 feet deep through the bars below Ayletts and the removal of logs, snags, overhanging trees, wrecks, etc., as far up as Munday Bridge.

Up to the close of the fiscal year ending June 30, 1891, $16,296.89 had been expended in removing snags, wrecks, logs, and other obstructions between Robinson Bar and Munday Bridge, a distance of 34 miles, and in building 2,226 linear feet of dike at Robinson Bar. The appropriation of $3,000 made September 19, 1890, was too small to be applied to dredging operations, and was applied to removing snags, leaning trees, etc., which obstructed navigation. The plant formerly used for this purpose on the Rappahannock, Pamunkey, and Mattaponi rivers having become worn out, the construction of a new plant became necessary. At the close of the fiscal year ending June 30, 1891, this plant was nearly completed.

The new plant was delivered on July 15, 1891, and after being employed on the Pamunkey River was brought to the Mattaponi, where snagging operations were commenced October 1, 1891. The work covered that part of the river between West Point and Dunkirk, the last-named place being about 6 miles above Ayletts; 165 snags, 27 logs, and 210 overhanging trees were removed. The season's work was concluded November 21, 1891, and the plant was then taken to the Rappahannock River for use on that improvement.

July 1, 1891, balance unexpended	$3,003.11
June 30, 1892, amount expended during fiscal year	2,870.50
July 1, 1892, balance unexpended	132.61
Amount appropriated by act approved July 13, 1892	4,000.00
Amount available for fiscal year ending June 30, 1893	4,132.61
Amount (estimated) required for completion of existing project	16,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix J 11.)

12. *Pamunkey River, Virginia.*—The Pamunkey River has a navigable length of 59 miles and empties in the York River at West Point, Va. Navigation was originally obstructed by five bars in the upper part of the river and by snags, logs, and overhanging trees.

The project was adopted in 1880 and amended in 1885, and provides for channels 100 feet wide and 7 feet deep through Spring Bar and Skidmore Bar, or to a distance of 47 miles above West Point, and channels 40 feet wide and from 3 to 5 feet deep through the bars above, together with the removal of logs, wrecks, snags, and overhanging trees. On June 30, 1890, logs, snags, etc., had been removed from 22.5 miles of the river between Garlick Ferry and Hanovertown, dikes had been built at Spring Bar and Skidmore Bar, and a channel 95 feet wide and from 6 to 7 feet deep dredged through the last-named bar. The amount expended to June 30, 1890, was $18,483.64. An appropriation of $3,000 was made September 19, 1890, which was applied to the removal of snags, trees, and similar obstructions, which are annually renewed by freshets. The plant formerly used for this work having become worn out and useless, it became necessary to construct a new one. This was completed and snagging operations were commenced in July, 1891.

The entire river between West Point and Hanovertown was examamined, and 103 snags, 37 logs, and 103 overhanging trees were removed. Work was closed on September 26, 1891, and the plant then transferred to the Mattaponi River.

July 1, 1891, balance unexpended	$3,016.36
June 30, 1892, amount expended during fiscal year	2,963.02
July 1, 1892, balance unexpended	53.34
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	3,053.34
Amount (estimated) required for completion of existing project	7,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix J 12.)

EXAMINATIONS AND SURVEYS, MADE IN COMPLIANCE WITH PROVISIONS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Lieut. Col. Hains, and reports thereon submitted. It is his opinion, based upon the facts and reasons given, that these localities are worthy of improvement. This opinion being concurred in by me, Lieut. Col. Hains was charged with and has completed their survey and submitted reports thereon. The reports were transmitted to Congress and printed as executive documents, Fifty-second Congress, first session.

1. *Eastern Branch of the Potomac River* (*Anacostia River*), *including*

that portion in District of Columbia.—The improvement recommended contemplates dredging a channel 24 feet deep and 200 feet wide from the mouth up to the Navy-Yard Bridge, with a basin in front of the navy-yard 400 feet wide and 24 feet deep; this channel to be widened, at a reduced depth, to 1,000 feet, as the demands of commerce may require in the future. The material dredged is to be deposited on the flats or marshes on either side of the river. For the present, it will be sufficient to dredge a channel 20 feet deep up to the navy-yard. The total cost of this work is estimated at $656,000.

Lieut. Col. Hains states:

> Before the project is regularly entered upon, steps should be taken to secure the title of the United States to all the land to be reclaimed. This will require the action of Congress.

Printed as House Ex. Doc. No. 30. (See also Appendix J 13.)

2. *Potomac River, Virginia and Maryland, up to the city of Washington, with the view of removing obstructions and deepening the channel.*—The improvement recommended contemplates the formation of a channel 200 feet wide and 24 feet deep at low tide through the five obstructions to 24-foot navigation in the river up to Georgetown, at an estimated cost of about $300,000, as follows:

Kettle Bottom Shoals	$1,320
Maryland Point Shoal	30,195
Smiths Point Shoals	33,000
Mattawoman Shoals	93,885
At Washington	141,504
Total	299,904

Printed as House Ex. Doc. No. 33. (See also Appendix J 14.)

EXAMINATION AND SURVEY, MADE IN COMPLIANCE WITH PROVISIONS OF ACT APPROVED MARCH 3, 1891.

The required examination and survey *for a breakwater to form a harbor of safety and refuge in Lynnhaven Bay, near Cape Henry, at the foot of Chesapeake Bay, Virginia*, were made by Lieut. Col. Hains, and his report thereon submitted. The cost of a breakwater 4,500 feet long, constructed of concrete blocks laid close and bonded together, upon a riprap base, with the approximate location selected, is estimated at $1,555,538. The report was transmitted to Congress and printed as House Ex. Doc. No. 27, Fifty-second Congress, first session. (See also Appendix J 15.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN SOUTHEASTERN VIRGINIA AND NORTHEASTERN NORTH CAROLINA.

Officers in charge, Capt. G. J. Fiebeger, Corps of Engineers, to November 30, 1891, and Lieut. Edward Burr, Corps of Engineers, since that date; Division Engineer, Col. Wm. P. Craighill, Corps of Engineers.

1. *Harbor of Norfolk and its approaches, Virginia.*—In 1877, previous to commencing the present improvement, the harbor of Norfolk was obstructed by shoals at the mouths of the Eastern and Southern branches, the shoal in the Eastern Branch being about one-third of a mile long, with a low-water depth of 15 to 16 feet, and the shoal in the Southern Branch being short and with a depth of from 22 to 23 feet. The approaches to the harbor were obstructed by shoals at Sewall Point, 3 miles long, with a low-water depth of 20 feet, and at the mouth

of the Western Branch, 1 mile long, with a depth of 19 feet. The depths on all these shoals and the width of the channels, particularly on the inner harbor where encroached upon by the Portsmouth and Berkley flats, were insufficient for the requirements of the port.

The plan of improvement adopted in 1878 was to deepen and widen the channels at the mouth of the Southern Branch and along the Portsmouth and Berkley flats in the harbor proper, and to improve the approaches to the harbor by dredging a channel 500 feet wide and 25 feet deep at ordinary low water through the shoals at Sewall Point and at the mouth of the Western Branch.

The revised project of 1885 is as follows: (1) To dredge a channel not less than 500 feet wide and 25 feet deep at ordinary low water from the deep water in Hampton Roads to Norfolk and the United States navy-yard on the Southern Branch, and also to dredge a channel in the Eastern Branch not less than 22 feet deep at ordinary low water, with a width of 700 feet at its mouth and not less than 300 feet at the Norfolk and Western Railroad Bridge; (2) to ultimately dredge the entire area bounded by lines parallel to and 75 feet from the port-warden lines to a depth not less than 25 feet from Fort Norfolk to the United States navy-yard, and not less than 22 feet from the mouth of the Eastern Branch to Campostella Bridge, and to build a bulkhead at Berkley Flats.

To the project of 1885 there was added in 1890 the dredging of an anchorage at the mouth of the Western Branch, with a depth of not less than 25 feet, at an estimated cost of $150,000, which amount was added to the original estimate.

With slight modifications all operations have been conducted in accordance with the adopted projects.

The amount expended to June 30, 1891, was $498,716.09, from which resulted a channel not less than 350 feet wide and 25 feet deep from Hampton Roads to Norfolk Harbor, a channel of the same depth and from 125 feet to 500 feet wide in the Southern Branch to the United States navy-yard, and a channel not less than 22 feet deep and 200 feet wide in the Eastern Branch to the Norfolk and Western Railroad Bridge.

The channels thus dredged were in good condition, except the bar at the mouth of the Eastern Branch, which by 1889 had shoaled to 20 feet, and the bar at the mouth of the Southern Branch, which had shoaled to 22 feet.

Under the appropriation of September 19, 1890, a contract was made with the National Dredging Company, of Wilmington, Del., to remove about 1,260,000 cubic yards of material before May 30, 1892. Under this contract there were removed, previous to July 1, 1891, from Sewall Point Bar, 273,022 cubic yards of material. During the present fiscal year the contractors have removed the following amounts of material: Sewall Point Bar, 233,756 cubic yards; Eastern Branch, 279,114 cubic yards; anchorage and channel at Western Branch, 478,834 cubic yards. The total for the year was 991,704 cubic yards and the total for the contract, which was completed May 14, 1892, was 1,264,726 cubic yards.

The channel through Sewall Point Bar was increased in width from 350 feet to 500 feet, with a depth not less than 25 feet. The bar at the mouth of the Eastern Branch was redredged to 22 feet depth and a portion of Berkley Flats, 240 feet wide and 1,400 feet long, was dredged to 16 feet. The dredging at the Western Branch produced 32 acres of the proposed anchorage, with a depth not less than 25 feet, and made more available 17 acres requiring no dredging.

During this fiscal year there was expended $130,526.90, which was applied to payments on contract, office expenses, surveys, care of property, etc.

Upon the completion of the contract examinations were made of the dredged channels, showing them all to be in good condition, except at the mouth of the Southern Branch, which has the same depth as in 1889.

July 1, 1891, balance unexpended	$136,315.20
June 30, 1892, amount expended during fiscal year	130,526.90
July 1, 1892, balance unexpended	5,788.30
July 1, 1892, outstanding liabilities	45.75
July 1, 1892, balance available	5,742.55
Amount appropriated by act approved July 13, 1892	150,000.00
Amount available for fiscal year ending June 30, 1893	155,742.55
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	307,744.56

(See Appendix K 1.)

2. *Approach to Norfolk Harbor and the United States (Norfolk) Navy-Yard, between Lambert Point and Fort Norfolk.*—In its original condition the channel in this portion of the approach to Norfolk Harbor was obstructed by a shoal at the mouth of the Western Branch, about 1 mile long, on which there was 19 feet at ordinary low water.

The project of 1878 was to dredge through this shoal a channel 500 feet wide with a depth of not less than 25 feet at ordinary low water.

The revised project of 1886 is (1) to secure a channel not less than 500 feet wide and 25 feet deep at ordinary low water from Lambert Point to Fort Norfolk by the construction of a dike and by dredging, and (2) to ultimately widen this channel to within 75 feet of a straight line drawn from Fort Norfolk to the deep water off Lambert Point, 6,800 feet of which is the proposed port-warden line, making the channel at least 700 feet wide.

The amount expended on this improvement between July 5, 1884, and June 30, 1891, was $196,638.43, from which resulted a channel between Lambert Point and Fort Norfolk 700 feet wide and 25 feet deep at ordinary low water and a channel of the same depth and 600 feet wide from deep water off Lambert Point to the port-warden line.

During the year ending June 30, 1892, there was expended on this improvement $861.57, which was applied to surveys, office expenses, and care of property.

The project of 1886 has been completed with the exception of the dike. The survey of 1889 and examinations of April, 1890, and May, 1891, did not show any shoaling of the dredged channel. A survey made in May, 1892, shows a shoaling on the eastern side of the channel thought not to be due to natural causes. This can only be determined by later surveys, but it is thought that the dike will not be necessary for the maintenance of the channel. No further appropriations will be required for this project at present.

July 1, 1891, balance unexpended	$861.57
June 30, 1892, amount expended during fiscal year	861.57
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	108,000.00

(See Appendix K 2.)

3. *Hampton Creek and Bar, Virginia.*—An examination and survey of this river were made in 1875 in accordance with the river and harbor act of June 23, 1874.

The channel in the river was at that time 60 feet wide and 8 feet deep at mean low water. Over the bar the depth was only 6 feet.

The plan of improvement adopted was to secure a channel 150 feet wide and 9 feet deep at low water in the creek and over the bar. This improvement was secured June 30, 1880, at a cost of $12,000.

The river and harbor act of August 11, 1888, called for an examination and survey, with a view to continuing the improvement.

It was recommended that the channel dredged in 1879–'80 be widened to 200 feet in the creek and from 200 to 300 feet over the bar, at a total cost of $10,000.

This amount having been appropriated in the river and harbor act of 1890, a survey was made of the creek and a contract entered into for the necessary dredging.

The amount expended on the present project to June 30, 1891, was $127.26, which was applied to surveys and office expenses.

During the fiscal year ending June 30, 1892, $9,872,74 was expended on this improvement and was applied to payments on contract, surveys, and office expenses. Eighty-four thousand three hundred and twenty-one cubic yards of material was removed under contract. Through the bar the channel was increased to 300 feet in width, and in the creek to 200 feet in width for about 2,400 feet, and 160 feet for a further distance of about 1,200 feet or to the head of navigation. The depth obtained was 9 feet at ordinary low water.

The project being completed no further appropriation is required for this improvement.

July 1, 1891, balance unexpended	$9, 872. 74
June 30, 1892, amount expended during fiscal year	9, 872. 74

(See Appendix K 3.)

4. *Nansemond River, Virginia.*—This river is one of the important tributaries of Hampton Roads, Virginia, and is navigable at high water for vessels drawing 11 feet as far as the city of Suffolk, 16 miles from its mouth.

Five railroads, two of which terminate at this place, put this city in communication with the South and West, and two lines of steamers run between it and Norfolk and Baltimore.

In 1872, before any improvement was undertaken, the navigable channel of the Nansemond River was 5 feet deep at low water and was much obstructed by wrecks, snags, etc.

Between 1873 and 1878 the Government dredged a channel, wherever necessary, 8 feet deep at low water from Suffolk to Hampton Roads, at a cost of $37,000.

This depth not being sufficient to meet the demands of its growing commerce, in obedience to the requirements of the river and harbor act of August, 1886, an examination and survey of the river were made to determine what other improvement was necessary.

The plan of improvement then proposed and since adopted is to secure a channel not less than 100 feet wide at bottom, 12 feet deep at mean low water, from the head of navigation to the mouth of Western Branch, 5.37 miles, including a turning basin 200 feet square, 300 feet below Suffolk Bridge, by dredging and the construction of spurs and training walls, and a channel of like depth from mouth of Western Branch to deep water at Town Point, 200 feet wide at bottom at its upper end and gradually increasing to at least 400 feet at its lower end, etc., the total estimated cost being, in round numbers, $152,500.

The amount expended on the present project to June 30, 1891, was $8,584.33, which was applied to dredging a channel 40 feet wide and 11 feet deep at ordinary low water through Suffolk Shoal, also to repairs to dikes.

Ten thousand dollars was appropriated for this improvement by the act of September 19, 1890, and contract was made with the Alabama Dredging and Jetty Company of Mobile, Ala., to do the required dredging, the work to be completed by June 30, 1892.

To June 30, 1892, the contractor had failed to begin work and on his application an extension of sixty days to the contract time of completion was granted.

During the fiscal year ending June 30, 1892, $41.50 was expended, which was applied to office expenses.

July 1, 1891, balance unexpended	$11,415.67
June 30, 1892, amount expended during fiscal year	41.50
July 1, 1892, balance unexpended	11,374.17
July 1, 1892, amount covered by uncompleted contracts	9,700.00
July 1, 1892, balance available	1,674.17
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	11,674.17
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	122,500.00

(See Appendix K 4.)

5. *Chickahominy River, Virginia.*—This river is one of the principal tributaries of the James and is navigable at high water for vessels drawing 10 feet to Windsor Shades and for vessels drawing 12 feet to Binn Bar, 2½ miles below Windsor Shades. The latter place, which is the head of navigation, is 25 miles from the mouth of the river.

Before improvement the channel from Windsor Shades to Binn Bar was obstructed by several shoals, over which the depth was 4 to 5 feet at low water; the entrance to the river was also obstructed by a bar.

The existing project of improvement is to dredge a channel from 100 to 150 feet wide and at least 8 feet deep at low water through the shoals near the head of navigation and a channel 200 feet wide and 14 to 15 feet deep at low water through the bar at the mouth. The rise of the tide is about 3 feet.

Up to June 30, 1891, $21,590.98 had been expended on this project. The channel through the bar had been completed, and that through the shoals given a least depth of 6½ feet and a least width of 40 feet.

The improved portion of the river was surveyed in January, 1891, and the dredged channels found in good condition.

Work under the contract made for dredging was commenced and completed in April, 1892; 13,000 cubic yards of material was removed, with the following results: The channel at Binn Bar was dredged 60 feet in width for a distance of 1,000 feet. At Osborne Bar the channel width was increased from 30 to 60 feet for a distance of 570 feet. At Old Fort Bar the channel was dredged 80 feet wide for a distance of 550 feet, and a point below the bar 50 feet by 150 feet was removed. At Windsor Shades Bar a channel 40 feet wide was dredged 1,400 feet long. All these channels were dredged to a depth not less than 9 feet at low water. The amount expended on this improvement during fiscal year ending June 30, 1892, was $2,221.71, which was applied to payments on contract, office expenses, etc.

July 1, 1891, balance unexpended	$2,409.02
June 30, 1892, amount expended during fiscal year	2,221.71
July 1, 1892, balance unexpended	187.31
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,187.31

(See Appendix K 5.)

6. *Appomattox River, Virginia.*—This is one of the principal tributaries of the James River, into which it empties at City Point, Va.

It is navigable as far as the city of Petersburg, about 11 miles from its mouth.

Before improvement this river had a tortuous channel, obstructed by shoals, over which there was about 6½ feet of water at high tide.

The plan of improvement, adopted in 1870, was to secure a channel 12 feet deep at high tide, with as much width as the river would bear.

The amount expended by the United States up to June 30, 1891, was $397,329.54, which resulted in maintaining a channel 10 to 12 feet deep in this river since 1874 and permanently securing this depth over most of the shoals.

The method of improvement consists in constructing regulating works, revetments, jetties, dikes, etc., resorting to the dredge to remove occasional shoals formed by freshets.

As this river is subject to annual freshets, which bring down and deposit larger quantities of sand than the current in the navigable portion can carry off, a small annual expenditure for dredging and repair work will be necessary after the regulating works have been completed.

The amount expended on this improvement during the fiscal year ending June 30, 1892, was $7,258.09, which was applied to payments on contract, work by hired labor, office expenses, and care of property.

The contract work, comprising 18 jetties, with an aggregate length of about 2,200 feet, and 892 feet of pile and brush dike, was completed. By hired labor all dikes were refilled with brush; Rushmore dam was replaced by a gravel dam; the closure dike was strengthened by a brush and gravel dam in rear, and a dam of brush and gravel was placed across Steins Cut.

Complaint having been made of shoals having been formed by freshets at the lower end of Puddledock Cut and on Magazine Bend, authority was obtained and work commenced upon their removal by hired labor, the use of Government plant, and the hire of dredge belonging to the city of Petersburg, Va.

July 1, 1891, balance unexpended	$11,420.46
June 30, 1892, amount expended during fiscal year	7,258.09
July 1, 1892, balance unexpended	4,162.37
July 1, 1892, outstanding liabilities	231.70
July 1, 1892, balance available	3,930.67
Amount appropriated by act approved July 13, 1892	15,080.00
Amount available for fiscal year ending June 30, 1893	19,010.67

(See Appendix K 6.)

7. *Inland water route from Norfolk Harbor, Virginia, to Albemarle Sound, North Carolina, through Currituck Sound.*—This is one of the

most important links in the chain of inland water communication along the Atlantic coast.

It connects Chesapeake Bay with Albemarle Sound and is composed of the following bodies of water: Elizabeth River, North Landing River, Currituck Sound, Coanjok Bay, North River, and the Albemarle and Chesapeake Canal. With the exception of the canal, which was constructed and is maintained by private enterprise, all are natural waterways.

Before any improvement was undertaken by the Government there was over this route an indifferent channel 5 to 7 feet deep at low water, the navigation of which was obstructed by snags, overhanging growth, and sharp bends in all the rivers.

The project adopted was to secure a channel 80 feet wide and 9 feet deep at low water over the entire route, about 58 miles, by dredging, removing obstructions, and constructing a dike.

Steady progress has been made toward securing this result, and at present the regular steamboat lines running between North Carolina ports and Norfolk and Baltimore employ vessels whose maximum dimensions are: length, 190 feet; width, 25.2 feet; draft, 8 feet, and tonnage, 421.

In the river and harbor acts before that of September 19, 1890, three separate items were inserted for this improvement; in that of September 19, 1890, one item was made to cover the entire route.

The total expenditure up to June 30, 1891, was $235,089.89.

Work was commenced on the Southern Branch of the Elizabeth River under contract in December, 1891, and completed in March, 1892, 32,308 cubic yards of material being removed. Nine shoals, having a total length of 7,950 feet, were dredged to not less than 9 feet deep for a channel not less than 50 feet wide. Another shoal 600 feet long was dredged 25 feet wide, and a width of 50 feet was removed from a point of shoal.

The amount expended during the fiscal year ending June 30, 1892, upon this improvement was $8,742.39, which was applied to payments on contract, office expenses, etc.

July 1, 1891, balance unexpended	$9,480.96
June 30, 1892, amount expended during fiscal year	8,742.39
July 1, 1892, balance unexpended	738.57
Amount appropriated by act approved July 13, 1892	9,000.00
Amount available for fiscal year ending June 30, 1893	9,738.57
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	49,677.08

(See Appendix K 7.)

8. *North Landing River, Virginia and North Carolina.*—This river forms part of the "inland water route from Norfolk to Albemarle Sound" described above.

Before improvement the navigation of this river was obstructed by shoals, over which the depth was 6 feet at low water, by snags, and by sharp bends.

The plan of improvement adopted in 1879 was to secure a channel 80 feet wide and 9 feet deep at low water by dredging shoals and removing bends and obstructions.

This project was completed June 30, 1884, at a cost of $49,777.34, and the desired channel obtained for a distance of 17 miles. Since that time $3,057.35 has been expended on this river in removing sunken logs which have become detached from passing rafts.

There is still a small balance on hand for the continuation of this work, and no further appropriation is necessary.

July 1, 1891, balance unexpended	$2,665.31
July 1, 1892, balance unexpended	2,665.31

(See Appendix K 8.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN VIRGINIA, NORTH CAROLINA, AND SOUTH CAROLINA.

Officers in charge, Capt. W. H. Bixby, Corps of Engineers, to October 31, 1891, with Lieut. Mason M. Patrick, Corps of Engineers, under his immediate orders; Lieut. Mason M. Patrick, Corps of Engineers, in temporary charge from October 31, 1891, to January 1, 1892; and Maj. W. S. Stanton, Corps of Engineers, in charge since January 1, 1892, having under his immediate orders Lieut. Mason M. Patrick, Corps of Engineers, to April 21, 1892, and Lieut. E. W. Van C. Lucas, Corps of Engineers, since April 30, 1892; Division Engineer, Col. Wm. P. Craighill, Corps of Engineers.

1. Staunton River, Virginia.—The improvement has been restricted to two sections, aggregating 65 miles in length and separated by an interval of 20½ miles.

When, in 1879, the United States commenced the improvement of the lower section, 31½ miles long, from Randolph up to Brook Neal, the channel depth at about 18 rock ledges was only 1 to 2 feet, but elsewhere 4 to 5 feet at low water.

The project of 1879, not since modified, was to secure a boat channel way 35 feet wide and at least 2 feet deep at low water throughout the 31½ miles.

When, in 1883, the United States commenced the improvement of the upper section, 23½ miles long, from the Virginia Midland Railroad Bridge up to Pig River, the channel depth at about 20 rock shoals was only about .4 foot, and elsewhere about 2 feet at ordinary stages of water.

The project of 1883, as modified in 1884 and 1887, was to secure a bateau channel way 14 feet wide and 1½ feet deep over the entire section.

To June 30, 1891, $44,500 was expended upon the improvement of the two sections.

At that date the proposed channel had been obtained for 29½ miles of the middle part of the lower section, and for 18½ miles of the upper section, giving for the 31½ miles of the former a fairly cleared channel for steamers of 2 feet draft and of about 25 tons burden, and making navigation for pole boats fairly good over the entire upper section up to Pig River.

October 31 and November 9 the discontinuance of the improvement was recommended by the district engineer and division engineer, and approved November 10, 1891, by the Chief of Engineers.

No work has been done during the fiscal year ending June 30, 1892.

July 1, 1891, balance unexpended	$7,981.74
June 30, 1892, amount expended during fiscal year	147.00
July 1, 1892, balance unexpended	7,834.74
July 1, 1892, outstanding liabilities	34.74
July 1, 1892, balance available	7,800.00

Amount (estimated) required for completion of existing project	$50,200.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix L 1.)

2. Roanoke River, North Carolina.—When the United States commenced its improvement, in 1872, its navigation by vessels of 10 feet draft (as great as can be carried through Albemarle Sound), was embarrassed by the wreck of a gunboat 6 miles and by war obstructions at two points 9 and 13 miles above its mouth; also somewhat obstructed for that draft by snags in the channel and by leaning trees 67 miles to Indian Highland Bar; thence, 62 miles up to Weldon, its channel depth on the bars was about 5 feet during eight months annually, but reduced to 2 feet during the annual season of extreme low water, and its channel was badly obstructed by snags, logs, stumps, leaning and overhanging trees.

The original project of 1872 is to secure, at all seasons of the year, an unobstructed channel, with a least width of 50 feet, from the mouth 129 miles to Weldon, with a depth of at least 10 feet 67 miles to Indian Highland Bar, and of at least 5 feet 62 miles farther, to Weldon, by removing the war obstructions, snags, fallen and overhanging trees, sand bars, and ledges, by dredging, the construction of training dikes, and blasting, at an estimated cost of $269,000.

To June 30, 1891, $119,040.37 had been expended upon the improvement.

At that date the channel, for a width of 100 feet, from the mouth 103 miles to Looking Glass Bar, and the river to its full width thence 26 miles to Weldon, were well cleared of snags, logs, and stumps to the depth of 10 feet up 62 miles to Hamilton, of 5 feet thence 41 miles to Looking Glass Bar, and of 3 feet 26 miles farther to Weldon; but the river was badly obstructed by leaning and overhanging trees at all the bends from Jamesville 85 miles to Looking Glass Bar.

The natural depth at extreme low water to the river bottom was not less than 10 feet 67 miles to Indian Highland Bar, and 5 feet 51 miles farther to Halifax, excepting at Spring Gut Bar, 35 miles below Halifax, where it was only 2½ feet, while at Looking Glass Bar, 15 miles below Halifax, the 5-foot channel was narrowed to from 30 to 70 feet in width.

At Halifax there was a bar, 2,450 feet in length, of rock and sand, with a depth of only 3.7 feet at extreme low water, and at the old railroad pier, 1¼ miles below Weldon, there was a sand bar 800 feet across with a depth of about 2 feet, while from the old Weldon Ferry there was a continuous ledge of rock 2,850 feet up to the old Weldon Landing, with only 1 foot of water upon it at extreme low stage; elsewhere from Halifax to Weldon the channel was 5 feet deep at extreme low water.

With the amount applied during the fiscal year ending June 30, 1892, the full width of the river, from Edwards Ferry down 41 miles to Hamilton, has been entirely cleared of snags to the depth of 7 feet 24 miles down to Palmyra and of 9 feet the remaining 17 miles to Hamilton.

July 1, 1891, balance unexpended	$19,983.99
June 30, 1892, amount expended during fiscal year	12,845.57
July 1, 1892, balance unexpended	7,138.42
July 1, 1892, outstanding liabilities	259.07
July 1, 1892, balance available	6,879.35
Amount appropriated by act approved July 13, 1892	50,000.00
Amount available for fiscal year ending June 30, 1893	56,879.35

Amount (estimated) required for completion of existing project	$81,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 2.)

3. *Pasquotank River, North Carolina.*—When the United States began its improvement in 1891 it had a good channel, nowhere less than 7 feet deep from its mouth at Albemarle Sound, 36 miles, to the Moccasin Track, with little or no obstruction 31 miles to Turners Cut; but its channel thence, 5 miles to the Moccasin Track, and the channel of the Moccasin Track, which has a natural depth of not less than 5 feet for 1,100 feet to the original entrance to the Dismal Swamp Canal were badly choked with snags, logs, and stumps, and obstructed by overhanging trees. And Turners Cut, an extension of the canal dug to a point on the river just below the obstructions to turn them, had shoaled by the caving of its sandy banks.

The river above the Moccasin Track was obstructed like the 5 miles next below it.

The present project, adopted in 1889, is, first, to clear the 5 miles of channel up to and in the Moccasin Track to the canal for navigation by all vessels that can pass through the canal and enable them to avoid Turners Cut, especially at periods of extreme low water; second, to thoroughly clear out the river 6 miles farther to Lebanon Bridge for navigation by flatboats, at an estimated cost of $9,000.

The amount expended under the project to the close of the fiscal year ending June 30, 1891, was $2,340.28.

At that date the Moccasin Track and a channel 60 feet wide, thence down 2½ miles to Richardson's Mills were thoroughly cleared, and a channel of the same width fairly cleared through the other 2½ miles of obstructions to the lower end of Turners Cut, permitting the passage of all vessels which can pass through the canal.

Since April 16, 1891, work has been suspended for want of funds.

July 1, 1891, balance unexpended	$722.30
June 30, 1892, amount expended during fiscal year	132.45
July 1, 1892, balance unexpended	589.85
July 1, 1892, outstanding liabilities	6.00
July 1, 1892, balance available	583.85
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	3,583.85

(See Appendix L 3.)

4. *Mackeys Creek, North Carolina.*—When the United States began to improve it in February, 1892, its navigation was impeded by a bar at its mouth in Albemarle Sound. The depth upon the crest in a somewhat circuituous channel was 7 feet.

The project of 1889 is to dredge through the bar a straight channel about 2,100 feet long, 100 feet wide, and 9 feet deep at low water, modified in May, 1892, by increasing the width to 140 feet. The estimated cost was $15,000.

To June 30, 1891, $359.48 had been expended upon this work.

At that date the bar had been surveyed but dredging had not been commenced.

During the fiscal year ending June 30, 1892, a straight channel 9 feet deep has been dredged through the bar 140 feet wide for a length of 1,524 feet and 120 feet for the remaining 576 feet.

July 1, 1891, balance unexpended		$14,650.52
June 30, 1892, amount expended during fiscal year		7,658.46
July 1, 1892, balance unexpended		6,992.06
July 1, 1892, outstanding liabilities	$4,053.09	
July 1, 1892, amount covered by uncompleted contracts	2,246.66	
		6,299.75
July 1, 1892, balance available		692.31

(See Appendix L 4.)

5. *Ocracoke Inlet, North Carolina.*—In 1828, when the United States began to improve the inlet, vessels drawing 9 feet could cross the ocean bar at low water, but the channel thence into Pamlico Sound was not practicable for vessels drawing more than 5 feet.

To 1837 the sum of $133,732.40 was expended, producing an increase of 3½ feet in the depth in one of the channels to Pamlico Sound, and "a material increase in the number of vessels seeking this outlet from North Carolina ports to the sea," but the shoaling of the dredged channel and destruction of a jetty constructed to prevent it led to the abandonment of the improvement.

In 1891, when the inlet was surveyed preparatory to resuming its improvement with the sum of $90,000 appropriated by the act of September 19, 1890, the depth in the channel on the bar was not less than 14 feet at mean low water and 4 to 6 feet in the channels thence to Pamlico Sound.

The project of 1889 is to dredge a channel 300 feet wide and about 6,000 feet across the inner bar, at an estimated cost, if 10 feet deep, of $100,000; if 13 feet deep, of $190,000, and if 15 feet deep, of $280,000, with the possible construction of necessary protecting dikes, at an additional cost of $320,000, aggregating $600,000.

To June 30, 1891, $1,747.71 had been expended.

At that date the inlet had been surveyed, but the improvement had not been commenced.

To June 30, 1892, no work has been done.

July 1, 1891, balance unexpended		$88,274.29
June 30, 1892, amount expended during fiscal year		404.57
July 1, 1892, balance unexpended		87,869.72
July 1, 1892, outstanding liabilities	$95.56	
July 1, 1892, amount covered by uncompleted contracts	75,000.00	
		75,095.56
July 1, 1892, balance available		12,774.16
Amount appropriated by act approved July 13, 1892		15,000.00
Amount available for fiscal year ending June 30, 1893		27,774.16

(See Appendix L 5.)

6. *Fishing Creek, North Carolina.*—When the first appropriation was made by Congress, September 19, 1890, for its improvement, its depth was about 4 feet at ordinary stages 38 miles to Bellamys Mills and its width 40 to 100, and occasionally 120 feet.

The project of 1889 is to clear it of snags, logs, and overhanging trees to Bellamys Mills.

To June 30, 1891, no money had been applied to the improvement, and no money has been applied to it during the fiscal year ending June 30, 1892, because the bridges over the creek have not been provided with draws as required by the law before any part of the money appropriated can be applied to the improvement.

July 1, 1891, balance unexpended	$10,000.00
July 1, 1892, balance unexpended	10,000.00
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	15,000.00
Amount (estimated) required for completion of existing project	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix L 6.)

7. *Pamlico and Tar River, North Carolina.*—(One river, called the Pamlico below and the Tar above Washington.) When the United States began to improve it in 1877 its channel was obstructed in two places below Washington by piles; just below Sparta by scuttled lighters; 1 mile below Tarboro by the wreck of a steamer; immediately below Washington by a bar with a depth of 5 feet at low water on its crest in the channel; between Washington and Tarboro the available depth was 2 to 3 feet not more than eight months annually, and above Washingtion the entire river was more or less obstructed by snags, logs, and stumps in its channel and by trees overhanging from its banks.

The project of 1875 is to secure by dredging and removal of war obstructions a clear and safe channel 9 feet deep at low water up to Washington, and of 1879 to clear a channel 60 feet wide, 3 feet deep at low water, 22 miles to Greenville, and 20 inches deep at low water 66 miles farther to Rocky Mount, at a total final estimated cost of $92,200.

To June 30, 1891, $68,793.13 had been expended upon this work.

At that date there was a channel up to Washington, crooked and difficult to run, with a minimum depth of about 7 feet, from which some stumps needed to be removed, and two troublesome shoals between Washington and Tarboro, with a depth upon one of only about 1 foot at low water. The river between Washington and Tarboro was at intervals considerably obstructed, and from Tarboro to Rocky Mount much obstructed by snags, logs, stumps, and overhanging trees.

With the amount applied during the fiscal year ending June 30, 1892, the channel has been cleared of snags, logs, and stumps, and the banks of leaning and overhanging trees from the falls at Rocky Mount down 64 miles to within 2 miles of Greenville.

July 1, 1891, balance unexpended	$9,256.21
June 30 1892, amount expended during fiscal year	6,148.39
July 1, 1892, balance unexpended	3,107.82
July 1, 1892, outstanding liabilities	832.67
July 1, 1892, balance available	2,275.15
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	12,275.15
Amount (estimated) required for completion of existing project	42,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix L 7.)

8. *Contentnia Creek, North Carolina.*—When the United States began to improve it in 1881 it was badly choked with fallen timber, snags, logs, and stumps; also obstructed by sand bars, and navigation rendered exceedingly difficult, in many places next to impossible, by the dense overhanging growth.

The project of 1881 is to clear it 63 miles to Stantonsburg of overhanging trees and its channel of snags and logs to a depth of not less than 3 feet at the flush-water stages of eight or nine months' annual duration, at an estimated cost of $77,500.

To June 30, 1891, $48,701.50 had been expended upon this work.

At that date the channel to the depth of 3 feet had been moderately cleared 31 miles up to Snow Hill, and roughly cleared 32 miles farther to Stantonsburg.

During the fiscal year ending June 30, 1892, no work has been done, awaiting a period of specially low water for clearing Spring Slough, near the mouth of the creek, of snags and stumps.

July 1, 1891, balance unexpended	$3,588.90
June 30, 1892, amount expended during fiscal year	1,341.25
July 1, 1892, balance unexpended	2,247.65
July 1, 1892, outstanding liabilities	37.10
July 1, 1892, balance available	2,210.55
Amount appropriated by act approved July 13, 1892	7,000.00
Amount available for fiscal year ending June 30, 1893	9,210.55
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	18,500.00

(See Appendix L 8.)

9. Trent River, North Carolina.—When the United States began to improve it in 1879 the river was comparatively free from obstructions from Newbern, 21 miles, to Pollocksville, between which points a draft of 6 feet could be carried at low water; above Pollocksville it was obstructed by bars of sand and rock, and especially by great numbers of snags in the 14 miles from Quaker Bridge up to Trenton. One steamer ran regularly to Pollocksville and one occasionally 9 miles farther to Quaker Bridge, above which point navigation was confined to flat boats and rafts.

The project of 1879 was to secure a channel 3 feet deep at low summer stage from Pollocksville to Trenton by removing all obstructions and dredging a cut 50 feet wide through the shoals, at a cost, estimated in 1887, at $59,000.

In 1889 the project was extended to remove obstructions to permit navigation by small steamboats 33 miles above Trenton and by pole boats 6½ miles farther, to Upper Quaker Bridge, at an additional cost of $13,000, the two projects aggregating $72,000.

To June 30, 1891, $53,897.07 had been expended upon this work.

At that date the channel had been cleared of snags, etc., and the banks of overhanging trees from the mouth to Trenton, and fairly cleared 7 miles above that point; a channel 3 feet deep at low water and 50 to 75 feet wide had been dredged through the shoals between Pollocksville and Trenton; a turning basin had been dredged and revetted at Trenton, and a channel dredged to the depth of 8 feet and width of 100 feet through Foys Shoal, 6 miles above Newbern. But steamers which the improvement had enabled to make regular trips to Trenton had again been prevented from ascending to it by shoals which had reformed in the 2 or 3 miles immediately below that place.

With the amount applied during the fiscal year ending June 30, 1892, the river has been carefully surveyed from Trenton, 39½ miles, to Upper Quaker Bridge, but the funds available have been insufficient for other work.

July 1, 1891, balance unexpended	$1,640.56
June 30, 1892, amount expended during fiscal year	1,031.84
July 1, 1892, balance unexpended	608.72
July 1, 1892, outstanding liabilities	25.50
July 1, 1892, balance available	583.22
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,583.22
Amount (estimated) required for completion of existing project	11,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 9.)

10. *Neuse River, North Carolina.*—When the United States began to improve it in 1878 the minimum channel depth during nine months annually was 9 feet from the mouth, 40 miles, up to Newbern; 4 feet thence, 50 miles, to Kinston; 3 feet, 46 miles farther, to Goldsboro; and 2 feet thence, 53 miles, to Smithfield. Between Newbern and Kinston there were long stretches of shoals, upon at least one of which the depth at the low-water season was only about 18 inches. The channel was obstructed at two points below Newbern and at two between Newbern and Kinston by inclined iron-pointed spars, and boxes or vessels or cribs filled with stones. From Contentnia Creek up 119 miles to Smithfield the river was badly obstructed by overhanging trees and by dense masses of logs and snags in the channel.

The project of 1871, as modified or extended in 1878, 1879, 1880, and 1883, is to remove the war obstructions, to clear the channel to Smithfield of all snags, logs, and overhanging trees; to contract the channel way by jetties so as to insure during the entire year an unobstructed 8-foot navigation to Newbern, a similar 4-foot navigation to Kinston, and during nine months annually a 3-foot navigation to Smithfield, at a total final estimated cost of $374,000.

To June 30, 1891, $253,900.86 had been expended upon this work.

At that date there was an 8-foot navigation to Newbern, but between Newbern and Kinston there were nine shoals, aggregating 3,150 feet in length, on some of which the depth at low water was about 1½ feet and on others about 2½ feet, and the river was somewhat obstructed by snags, logs, stumps, and overhanging trees, and also for 23 miles above Kinston.

With the amount applied during the fiscal year ending June 30, 1892, the channel to a width of 120 to 250 feet, and banks for 23 miles immediately above Kinston and for 23½ miles between Kinston and Newbern, were cleared of snags, logs, stumps, and overhanging trees, leaving the river, as regards obstructions other than shoals, in excellent condition to Goldsboro.

July 1, 1891, balance unexpended	$14,874.45
June 30, 1892, amount expended during fiscal year	6,149.63
July 1, 1892, balance unexpended	8,724.82
July 1, 1892, outstanding liabilities	23.90
July 1, 1892, balance available	8,700.92
Amount appropriated by act approved July 13, 1892	15,000.00
Amount available for fiscal year ending June 30, 1893	23,700.92
Amount (estimated) required for completion of existing project	91.500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 10.)

11. Inland water way between Newbern and Beaufort, North Carolina.—(Via Neuse and Clubfoot rivers, Clubfoot and Harlowe Canal, and Harlowe and Newport rivers to Beaufort Harbor.) When the United States began to improve it in 1885 it was navigable by boats 15 feet wide with 3-feet draft.

The project of 1884 is to secure a channel 30 feet wide at bottom and 5 feet deep at mean low water throughout the route by dredging in Clubfoot and Newport rivers and Harlowe Creek at a cost estimated in 1886 at $92,000.

To June 30, 1891, $27,079.40 had been expended upon this work.

At that date a channel 13,000 feet long, 30 feet wide, and 5 feet deep at mean low water had been dredged through the worst portions of Harlowe Creek, securing through it far better navigation than that through the canal, and vessels drawing 3½ feet made regular trips, "except when prevented by slides, caves, and consequent insufficient depth in the Newbern and Beaufort Canal," owned by a corporation.

Further work having been postponed (Annual Report, Chief of Engineers, 1891, page 161) to await cession or sale of the canal to the United States, no further appropriation is required until such cession or sale is made.

During the fiscal year ending June 30, 1892, no work has been done, the cession of the canal to the United States being awaited before the improvement is resumed.

July 1, 1891, balance unexpended	$7,920.60
June 30, 1892, amount expended during fiscal year	50.58
July 1, 1892, balance unexpended	7,870.02
July 1, 1892, outstanding liabilities	1.00
July 1, 1892, balance available	7,869.02
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	57,000.00

(See Appendix L 11.)

12. Harbor at Beaufort, North Carolina.—When its improvement by the United States (begun in 1836) was resumed in 1881, the erosion of Fort Macon and of Shackleford Points, and widening of the entrance between them caused serious shoaling of the channel on and inside the bar, across which there was then a mid-channel depth of not less than 15.3 feet at low water.

The project of 1881, as modified in 1887 and 1891, is to stop the erosion of the points by jetties to prevent the shoaling of the channel and harbor, and to dredge a channel 100 feet wide and 7 feet deep at mean low water from the bulkhead channel in the harbor about 1,800 feet long to the wharves at Beaufort at a cost estimated in 1887 at $163,000.

To June 30, 1891, $123,673.34 had been expended upon this work.

At that date the erosion of Fort Macon and Shackleford Points had been arrested, and a cut at least 50 feet wide and 5 feet deep at low water had been dredged from the bulkhead channel to the wharves at Beaufort.

With the amount applied to the improvement during the fiscal year ending June 30, 1892, 9,989.22 cubic yards of sand has been dredged, making a cut 714 feet long and 35 to 100 feet wide between the bulkhead channel and the wharves at Beaufort.

July 1, 1891, balance unexpended		$16,459.51
June 30, 1892, amount expended during fiscal year		2,412.56
July 1, 1892, balance unexpended		14,046.95
July 1, 1892, outstanding liabilities	$2,402.26	
July 1, 1892, amount covered by uncompleted contracts	8,670.26	
		11,072.52
July 1, 1892, balance available		2,974.43
Amount appropriated by act approved July 13, 1892		10,000.00
Amount available for fiscal year ending June 30, 1893		12,974.43
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		13,000.00

(See Appendix L 12.)

13. *Inland water way between Beaufort Harbor and New River, North Carolina.*—The application of the appropriations has been restricted to the 24 miles in Bogue Sound from Beaufort Harbor to Swansboro, because that is the more important part of the route, and because the other part, 22 miles long, from Swansboro to New River, is provided for by a special appropriation.

In 1888, when the United States began to improve the channel through Bogue Sound from Beaufort to Swansboro, there were several shoals aggregating upwards of 4½ miles in length, over which not more than 18 inches could be carried at low water; elsewhere the channel was not less than 3 feet deep.

The project of 1885 is to dredge a channel 100 feet wide and 3 feet deep at mean low water through the shoals at an estimated cost of $50,000.

To June 30, 1891, $19,504.81 had been expended upon this work.

At that date a channel 40 to 60 feet wide and 3 to 4 feet deep at low water had been dredged an aggregate length of 15,529 feet, leaving 8,588 feet still to be dredged.

With the amount applied during the fiscal year ending June 30, 1892, 33,005.06 cubic yards of material in the aggregate has been dredged from the channel in prolonging a cut 40 feet wide, 3 to 4 feet deep, 4,840 feet through Sanders Creek Shoal; in prolonging the cut 50 feet wide and 5 feet deep, 458 feet through Sally Bells Shoal, and widening it to 100 feet through its entire length of 938 feet, and in dredging a cut 2,800 feet long, 40 feet wide, and 3 to 4 feet deep at mean low water through the shoal at Broad Creek, thus completing a channel not less than 40 feet wide and 3 feet deep at mean low water through all the shoals between Beaufort and Swansboro.

July 1, 1891, balance unexpended	$10,967.39
June 30, 1892, amount expended during fiscal year	9,056.29
July 1, 1892, balance unexpended	1,911.10
July 1, 1892, outstanding liabilities	1,862.84
July 1, 1892, balance available	48.26
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	10,048.26
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	10,000.00

(See Appendix L 13.)

14. Inland water way between New River and Swansboro, North Carolina.—When the first appropriation was made, September 19, 1890, for its improvement, the crooked and intricate bayou which this water way follows, 22 miles through the marshes between the mainland and outlying sand banks, had, at low water, a minimum depth of about 6 inches upon the shoals or "divides" where the tides meet between the four inlets to it from the ocean and varied from 12 to 1,000 feet in width.

The project of 1889 is to dredge a channel 40 feet wide and 4 feet deep at high water through the shoals at a cost, estimated in 1891, at $52,000.

To June 30, 1891, $509.76 had been spent in surveying the shoals. At that date the work of improvement had not been commenced.

During the fiscal year ending June 30, 1892, no work has been done, because the Wrightsville and Onslow Navigation Company claims to control the water way under an act of the State of North Carolina of February 13, 1889. (See House Ex. Doc. No. 26, Fifty-second Congress, first session; reprinted in Appendix L 14.)

July 1, 1891, balance unexpended	$4,516.00
June 30, 1892, amount expended during fiscal year	133.75
July 1, 1892, balance unexpended	4,382.25
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	38,000.00

(See Appendix L 14.)

15. New River, North Carolina.—In 1886, when the United States began to improve it, there was a long and tortuous channel 50 feet wide and 3 feet deep at low water through extensive marshes and beds of oyster rock just within the inlet from the ocean. From the marshes up 23 miles its navigation was unimpeded for vessels of 5 feet draft, and there was a depth of about 4 feet at mean low water through the channel on the ocean bar.

The project, matured in 1885, is to dredge a straight channel 150 feet wide and 4 feet deep at mean low water 1,210 feet long through Wrights Island, and 5,710 feet long through Cedar Bush Marsh, and avoid the crooked and tortuous natural channel through the marshes and beds of oyster rock, at an estimated cost of $40,000.

To June 30, 1891, $19,688.03 had been expended upon this work.

At that date a straight channel had been dredged through Cedar Bush Marsh 5,800 feet long, 40 feet wide at bottom and 4 feet deep, excepting at the lower end, where its depth was 3.1 feet, and 1,210 feet long through Wrights Island to the depth of 4 feet at mean low water, and variable widths of 90, 100, and 120 feet.

To June 30, 1892, no further dredging has been done, and the cut at Cedar Bush Marsh has shoaled at each end so that it can be used only by vessels of very light draft.

July 1, 1891, balance unexpended		$8,343.04
June 30, 1892, amount expended during fiscal year		121.19
July 1, 1892, balance unexpended		8,221.85
July 1, 1892, outstanding liabilities	$2.00	
July 1, 1892, amount covered by uncompleted contracts	6,500.00	
		6,502.00
July 1, 1892, balance available		1,719.85
Amount appropriated by act approved July 13, 1892		5,000.00
Amount available for fiscal year ending June 30, 1893		6,719.85

Amount (estimated) required for completion of existing project	$7,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 15.)

16. *North East (Cape Fear) River, North Carolina.*—When the United States began to improve it in 1890 it was easily navigable from its mouth up 48 miles to Bannerman's Bridge, and its channel depth was not less than 6 feet at low water; for the next 40 miles to Hallsville its depth was about 3 feet at ordinary stages, and 13 miles farther to Kornegay's Bridge its depth and width were suited only to pole boats and rafts; everywhere above Bannerman's Bridge it was badly obstructed by snags and by overhanging and fallen trees, so as to completely block navigation at all ordinary stages of water.

The project of 1889 is to clear the channel to its natural depth and to good width for small light-draft steamers up to Hallsville, and for pole boats to Kornegay's Bridge, at an estimated cost of $30,000.

To June 30, 1891, $3,173,60 had been expended upon this work.

At that date the channel to its natural depth and a width of 40 feet had been cleared merely of the worst obstructions to a high-water navigation from Bannerman's Bridge up 31½ miles to Chinquapin.

With the amount applied during the fiscal year ending June 30, 1892, 33 logs and snags and parts of an old steamboat, scow, and boiler were taken from the channel near the mouth, and gauge observations kept at seven points.

July 1, 1891, balance unexpended	$1,866.40
June 30, 1892, amount expended during fiscal year	674.61
July 1, 1892, balance unexpended	1,191.79
July 1, 1892, outstanding liabilities	35.50
July 1, 1892, balance available	1,156.29
Amount appropriated by act approved July 13, 1892,	5,000.00
Amount available for fiscal year ending June 30, 1893	6,156.29
Amount (estimated) required for completion of existing project	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 16.)

17. *Black River, North Carolina.*—When the United States began to improve it in 1887 the channel, from the mouth 24 miles to Point Caswell, was fairly cleared, and not less than 4 feet deep at low summer stage, and was roughly cleared 62 miles farther to Lisbon, with a least channel depth of 2½ feet at low stage in the 10 miles from Point Caswell to Haws Narrows; thence 52 miles to Lisbon the depth at low summer stage was 18 inches to 3 feet on the shoals, and 10 to 12 feet in the pools.

The project of 1885 is to apply at least $10,000 to removing logs, snags, and overhanging trees from the bed and banks, and rounding off a few of the sharpest bends from its confluence with the Cape Fear River up 86 miles to Lisbon.

To June 30, 1891, $2,997.40 had been expended upon this work.

At that date navigation was unobstructed from the mouth 34 miles to Haws Narrows, excepting a few trees in the channel and leaning from the banks in the 6 miles next below Point Caswell, and between it and Haws Narrows, through which shoals of sand, formed by logs, reduced the depth to 18 inches. In the next 14 miles to South River Narrows navigation was not obstructed, but thence 34 miles to Lisbon was badly obstructed by snags, logs, stumps, and overhanging trees.

Excepting the appropriation by act of July 13, 1892, the $3,000 appropriated August 5, 1886, is the only appropriation made for this improvement, and no work has been done upon the river since September, 1889.

July 1, 1891, balance unexpended	$5.93
June 30, 1892, amount expended during fiscal year	5.93
Amount appropriated by act approved July 13, 1892	10,000.00

(See Appendix L 17.)

18. Cape Fear River, North Carolina, above Wilmington.—When the United States began to improve it in 1882 the depth of water was always ample and navigation unimpeded by shoals from Wilmington 49 miles up to Hungry Neck; thence 66 miles to Fayetteville there were many shoals on which the water was not more than 12 to 14 inches deep during the low stage; from Indian Wells Landing, 37 miles above Wilmington, 78 miles to Fayetteville the river was badly obstructed by snags, logs, and overhanging trees.

The project of 1881, as matured in 1885 and 1886, is to secure at all times of the year a depth of 4 feet from Wilmington 73 miles to Elizabethtown, and of 3 feet thence 42 miles to Fayetteville, by removing snags and rock from the bed and overhanging trees from the banks, by contracting the channel by jetties on the shoals, and by a little dredging at a bar of clay, at an estimated cost of $472,700.

To June 30, 1891, $94,350.43 had been expended upon this work.

At that date a channel 100 feet wide was fairly cleared from Wilmington 73 miles to Elizabethtown, and 80 feet wide 42 miles farther to Fayetteville. The least channel depth during the entire year was 4 feet from Wilmington 46 miles to Kellys Cove, 3 feet thence 27 miles to Elizabethtown, and 2 feet 42 miles farther to Fayetteville.

With the amount, $5,520.93, applied during the fiscal year ending June 30, 1892, the worst snags were taken from the channel in the 22 miles next below and 26 miles next above Elizabethtown; 793 linear feet of brush and stone jetties were built in the 12½ miles next below Fayetteville; the shoal at Elizabethtown was surveyed and the construction of jetties upon it commenced.

July 1, 1891, balance unexpended	$10,070.92
June 30, 1892, amount expended during fiscal year	5,520.93
July 1, 1892, balance unexpended	4,549.99
July 1, 1892, outstanding liabilities	530.30
July 1, 1892, balance available	4,019.69
Amount appropriated by act approved July 13, 1892	15,000.00
Amount available for fiscal year ending June 30, 1893	19,019.69
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	158,000.00

(See Appendix L 18.)

19. Cape Fear River, North Carolina, at and below Wilmington.—The United States began to improve the river between the bar and Wilmington in 1829 and the channel on the bar in 1853. In 1829 the river was so obstructed that vessels drawing more than 10 feet were obliged to anchor 14 miles below Wilmington and discharge a part of their cargoes into lighters. In 1853, at low water on the bar, the least mid-channel depth was 7 feet in the western channel, 7½ feet in the eastern channel, and 8 feet at New Inlet, 7 miles above the mouth.

The original project of 1827 was to deepen the channel through the shoals in the 8 miles next below Wilmington by contracting it by jetties and by diverting into it water from Brunswick River and from Fishing and Rodmans creek.

The project of 1853 was to straighten and deepen the channel on the bar by building jetties and a wing dam, by dredging, by diverting water through it from New Inlet, by building a jetty at Federal Point, and by closing two small breaches in Zekes Island.

The project of 1870 was to deepen the bar channel by closing the breaches between Smiths and Zekes islands, with the ultimate closure of New Inlet in view.

The project of 1873, to deepen the channel through the bar, added to that of 1870, to dredge in the Baldhead (eastern) Channel, to extend across Zekes Island and beyond it into the river, the dam then being built to close the breaches between Smiths and Zekes islands, and to close New Inlet, commencing with the building of a jetty from Federal Point.

The project of 1874 was "to get 12 feet at low water as high as the city of Wilmington" by dredging a channel 100 feet wide through Horseshoe Shoal below New Inlet and through three other shoals near Wilmington.

The project of 1881 was to dredge a channel 2¾ miles in length through Horseshoe Shoal, and through eight other shoals above it, 270 feet wide and 16 feet deep at mean low water from deep water at Smithville (Southport) to Wilmington.

The project of 1891 was to secure a channel 20 feet deep from Wilmington to the bar, by dredging a cut 270 feet wide and 20 feet deep at mean low water an aggregate length of 17.2 miles through ten shoals, and to increase the depth in the channel on the bar to 20 feet at mean low water, and secure it by the possible construction of stone jetties at an estimated aggregate cost of $1,800,000.

The present project, of June 9, 1892, is to obtain with the United States suction dredge *Woodbury* as great a depth as practicable, not to exceed 18 feet at mean low water, in the channel on the bar, and to dredge a channel 18 feet deep at mean low water through the shoals, thence to Wilmington, and as wide as the funds available in the next two year will permit, it being left to the experience of the next few years to decide whether it be necessary or expedient to work for a greater depth.

To June 30, 1891, $2,519,035.46 had been expended upon this work. At that date New Inlet had been closed and a continuous stone dam 3.3 miles in length had been completed, extending across the inlet, Zekes Island, and the breaches between Zekes and Smiths islands; crossing the bar, there was a tortuous channel having a minimum depth of 17 feet at mean low water; thence there was a channel 16 feet deep at mean low water and 233 to 270 feet wide through all the shoals to Wilmington; at the shoal at Wilmington a cut 2,100 feet in length had been dredged to the width of 270 feet and depth of 20 feet at mean low water.

With the amount applied during the fiscal year ending June 30, 1892, a channel has been completed 20 feet deep at mean low water, 270 feet wide and 3,200 in length, through Wilmington Shoal; to the same depth, 148 feet wide and 9,800 feet long, through Alligator Creek Shoal, and 37 to 74 feet wide and 7,700 feet long through Brunswick River Shoal; and a channel 40 to 80 feet wide and 18 feet deep at mean low water has been dredged, where shoaling had occurred, 1,649 feet long at New Snows Marsh Channel. The United States suction dredge *Woodbury* has also dredged 87,915 cubic yards of material from the channel on the bar and redredged 62,730 cubic yards from New Snows Marsh Channel.

June 30, 1892, the channel across the bar is somewhat straighter than one year ago and has a minimum depth of 17 feet at mean low water; thence to Wilmington the channel is 16 feet deep at mean low water through all the shoals excepting Lilliput Shoal, where for a distance of 300 feet the minimum depth is 15 feet. The 16-foot channel is 270 feet wide, excepting at Snows Marsh, where it is diminished by shoaling to a width of about 40 feet.

July 1, 1891, balance unexpended		$128,112.62
June 30, 1892, amount expended during fiscal year		91,762.39
July 1, 1892, balance unexpended		36,350.23
July 1, 1892, outstanding liabilities	$19,950.52	
July 1, 1892, amount covered by uncompleted contracts	764.64	
		20,715.16
July 1, 1892, balance available		15,635.07
Amount appropriated by act approved July 13, 1892		200,000.00
Amount available for fiscal year ending June 30, 1893		215,635.07
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		101,392.00

(See Appendix L 19.)

20. *Lockwoods Folly River, North Carolina.*—When the United States began this improvement, in 1892, the depth at low water was 5½ feet in the shifting channel on its ocean bar, within which the depth was 5 to 12 feet for 1½ miles to an expanse of mud flats and beds of oyster rock, over which for 1½ miles the river flowed with a width of one-fourth to three-fourths of a mile, and a depth of less than 1 foot at mean low water. A little above these flats was a shoal 300 feet long, upon which at mean low water the depth was 3½ feet; thence to Lockwoods Folly Bridge, 25 miles above the mouth, it was nowhere less than 5 feet and the width 70 to 200 feet.

The project of 1887 is to dredge a channel 100 feet wide and 7 feet deep at low water through the mud flats and beds of oyster rock and the shoal above, at a cost estimated in 1892 at $60,000.

To June 30, 1891, $19.81 had been expended.

At that date the bar had been surveyed, but dredging had not been commenced.

With the amount, $4,944.51, applied during the fiscal year ending June 30, 1892, a cut 40 feet wide and 5 feet deep at mean low water was dredged 2,530 feet in length, about one-third of the distance through the mud flats and beds of oyster rock.

July 1, 1891, balance unexpended	$4,980.19
June 30, 1892, amount expended during fiscal year	4,944.51
July 1, 1892, balance unexpended	35.68
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	3,035.68

Amount (estimated in 1887) required for completion of existing project.	$32,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 20.)

21. Yadkin River, North Carolina.—Its improvement is restricted to a section 33 miles in length, below and between which and its lower part, called the Great Pedee, which is navigable from tide water to near the southern boundary of the State, there intervenes a section of the river 111 miles in length containing many shoals, rapids, and falls which entirely preclude any attempt to make it navigable.

When the United States commenced to improve the section 64½ miles long from the railroad bridge near Salisbury to the foot of Bean Shoal, its navigation was completely obstructed by rock ledges, fishing and milldams, and numerous shoals, with a greatest depth of 1 foot at ordinary low water on some of its shoals and ledges. The estimated cost of the improvement was $400,000.

The project of 1879 was to secure a minimum depth of 2½ feet at ordinary stages nine months annually throughout the 64½ miles.

The present project, of 1887, is to secure this depth for a distance of 33½ miles only, next above the railroad bridge at Salisbury, at an estimated cost of $107,000.

To June 30, 1891, $98,971.45 had been expended upon this work. At that date it had a channel 40 to 70 feet wide, 2½ feet deep, about eight months annually, navigated only by flat and pole boats.

With the amount applied during the fiscal year ending June 30, 1892, 392 linear feet of dams has been built and 216 cubic yards of stone raised from the channel.

July 1, 1891, balance unexpended	$3,460.20
June 30, 1892, amount expended during fiscal year	3,004.38
July 1, 1892, balance unexpended	455.82
July 1, 1892, outstanding liabilities	57.25
July 1, 1892, balance available	398.57
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,398.57

(See Appendix L 21.)

22. Harbor at Georgetown, South Carolina.—This harbor is that part of the Sampit River immediately within the bar at its mouth near the head of Winyaw Bay.

When the United States began to improve it in 1884, there was in the channel on the ocean bar at the mouth of the bay at low water, about 8¾ feet and about 12 feet at high water, thence up the bay there was a depth of 13 feet to the bar at the mouth of the Sampit, upon which there was only 9 feet at ordinary low water.

The project of 1881 is to dredge a channel 200 feet wide to the depth of 12 feet at ordinary low water through this shoal or bar to permit vessels to reach the wharves at Georgetown.

To June 30, 1891, $23,935.73 had been expended upon this work.

At that date a channel 12 feet deep had been dredged entirely through the shoal with a minimum width of 80 feet, and for a part of its length of 100 feet.

With the amount applied during the fiscal year ending June 30, 1892, the minimum width of the 12-foot channel has been increased to 130 feet.

July 1, 1891, balance unexpended	$8,564.27
June 30, 1892, amount expended during fiscal year	8,189.39
July 1, 1892, balance unexpended	374.88
July 1, 1892, outstanding liabilities	16.00
July 1, 1892, balance available	358.88
Amount appropriated by act approved July 13, 1892	12,000.00
Amount available for fiscal year ending June 30,1893	12,358.88

(See Appendix L 22.)

23. Winyaw Bay, South Carolina.—When the United States began to improve it in 1890, there was at mean low water in the main (southerly) channel on its ocean bar 7 to 9 feet, and in the Bottle (easterly) Channel 6 to 8 feet of water, both channels being changeable; thence 12 miles to the head of the bay vessels could draw 12 feet at lowest tides.

The project of 1885, as approved by the Board of Engineer officers in 1888, and by the Chief of Engineers in 1889, is to increase the depth of water in Bottle Channel to about 15 feet at mean low water by building to the height of 6 feet above that plane a jetty from North Island 10,700 feet long, and a jetty from South Island 17,500 feet long across the main channel to the 15-foot curve, at a total estimated cost of $2,500,000.

To prevent the overflow to the depth of about 1 foot at mean high water of a wide expanse of marsh on the southerly side of the entrance to the bay, ensuing from the degradation of about 3 miles of beach, and hurtful changes of the tidal regimen of the bay, a dike 12,000 feet in length is to be built, at an estimated cost of $35,280, by authority from the Chief of Engineers of May 10, 1892.

To June 30, 1891, $32,836.88 had been expended upon this work.

At that date the necessary plant had been installed, and the north jetty and its two branches built to the mean water line.

With the amount applied during the fiscal year ending June 30, 1892, the north jetty has been built to a distance of 2,090 feet from the mean water line to a height of about 18 inches above mean low water, but not far enough to have any perceptible effect upon the channel on the bar; and 871 tons of stone have been placed on the jetty and its branches on shore.

July 1, 1891, balance unexpended		$191,758.81
June 30, 1892, amount expended during fiscal year		125,633.42
July 1, 1892, balance unexpended		66,125.39
July 1, 1892, outstanding liabilities	$34,351.18	
July 1, 1892, amount covered by uncompleted contracts	16,242.20	
		50,593.38
July 1, 1892, balance available		15,532.01
Amount appropriated by act approved July 13, 1892		100,000.00
Amount available for fiscal year ending June 30, 1893		115,532.01
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		2,181,250.00

(See Appendix L 23.)

24. Removing sunken vessels or craft obstructing or endangering navigation.—The wreck of an old schooner opposite Swan Point in Pamlico

River, North Carolina, reported in March, 1891, as obstructing and endangering navigation, was blown up and removed in August, 1891.

(See Appendix L 24.)

IMPROVEMENT OF LUMBER AND WACCAMAW RIVERS, NORTH CAROLINA AND SOUTH CAROLINA, AND OF CERTAIN RIVERS AND HARBORS IN SOUTH CAROLINA.

Officer in charge, Capt. Frederic V. Abbot, Corps of Engineers; Division Engineer, Col. William P. Craighill, Corps of Engineers.

1. *Waccamaw River to Waccamaw Lake, North Carolina and South Carolina.*—In 1880 this river was navigable for boats of 12 feet draft at all stages of water from Georgetown 23 miles to Bull Creek, and at high water 4 miles farther to Buck's lower mills; thence for boats of 7 feet draft at high water 22 miles farther to Conway; thence it possessed an obstructed channel for boats of 3 feet draft at ordinary winter water 68 miles to Reeves Ferry; thence an obstructed channel with 3 feet depth at high water 30 miles to Lake Waccamaw.

The project provides for a channel 12 feet deep at all stages of water and 80 feet bottom width from the mouth of the river to Conway; thence a cleared channel to Lake Waccamaw. The estimated cost is $138,400.

The work of the year has been snagging. Up to June 30, 1892, $77,900 has been spent, giving a thoroughly cleared channel with 100 feet least width, 7 feet deep at low water as far as Conway, and 40 feet width and 3 feet deep 68 miles above Conway.

The commerce of the past year passing over this river amounts to 83,103 tons.

July 1, 1891, balance unexpended	$4,199.54
June 30, 1892, amount expended during fiscal year	4,199.54
Amount appropriated by act approved July 13, 1892	10,000.00
Amount (estimated) required for completion of existing project	50,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M 1.)

2. *Lumber River, North Carolina and South Carolina.*—The river was obstructed by logs, snags, and overhanging trees, and in places by sand bars. It was crossed by a number of bridges without draws. The project contemplates the removal of snags, logs, overhanging trees, etc., for 70 miles below Lumberton, at an estimated cost of $35,000. The work of the year has been snagging. The bridges have been provided with draw spans or discontinued. The commerce of the year amounts to 6,800 tons. Total expenditures to June 30, 1892, $9,503.38.

July 1, 1891, balance unexpended	$4,356.94
June 30, 1892, amount expended during fiscal year	3,860.32
July 1, 1892, balance unexpended	496.62
July 1, 1892, outstanding liabilities	45.00
July 1, 1892, balance available	451.62
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,451.62
Amount (estimated) required for completion of existing project	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M 2.)

3. *Little Pedee River, South Carolina.*—This river was much obstructed by snags and overhanging trees, and in places was subdivided into several branches. The project contemplates providing for steamboat navigation to Lumber River and pole-boat navigation to Little Rock. The estimated cost is $50,000. The work of the year has been snagging. This year's commerce amounts to 7,115 tons. Total expenditures to June 30, 1892, $9,692.88.

July 1, 1891, balance unexpended	$2,861.59
June 30, 1892, amount expended during fiscal year	2,554.47
July 1, 1892, balance unexpended	307.12
July 1, 1892, outstanding liabilities	40.00
July 1, 1892, balance available	267.12
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,267.12
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	35,000.00

(See Appendix M 3.)

4. *Great Pedee River, South Carolina.*—The river was dangerously obstructed by snags and logs. The project provides for thoroughly cleared 9-foot navigation 52 miles to Smith Mills, and 3½-foot navigation to Cheraw, 172 miles above the mouth, at all stages of water, at an estimated cost of $117,000. The work of the year has been snagging. This year's commerce amounts to 92,471 tons. Total expenditures to June 30, 1892, $75,642.61.

July 1, 1891, balance unexpended	$9,460.98
June 30, 1892, amount expended during fiscal year	5,603.59
July 1, 1892, balance unexpended	3,857.39
July 1, 1892, outstanding liabilities	610.32
July 1, 1892, balance available	3,247.07
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	13,247.07
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	27,500.00

(See Appendix M 4.)

5. *Clark River, South Carolina.*—This river forms the southern mouth of Lynch River. Its upper end was entirely choked by driftwood and fallen trees. The project provides for closing the northern mouth of Lynch River and snagging Clark River. The estimate cost is $7,500. The work of the year has been snagging. This year's commerce amounts to 6,586 tons. Total expenditures to June 30, 1892, $5,000.

July 1, 1891, balance unexpended	$2,261.68
June 30, 1892, amount expended during fiscal year	2,261.68
Amount appropriated by act approved July 13, 1892	2,500.00

(See Appendix M 5.)

6. *Mingo Creek, South Carolina.*—This stream was much obstructed by snags and overhanging trees. The project provides for removing obstructions from the mouth to Williams Landing for steamboat navi-

gation and above for pole-boat navigation. The estimated cost is $17,000. The work of the year has been snagging. This year's commerce amounts to 55,280 tons. Total expenditures to June 30, 1892, $9,484.87.

July 1, 1891, balance unexpended	$3,077.67
June 30, 1892, amount expended during fiscal year	2,562.54
July 1, 1892, balance unexpended	515.13
July 1, 1892, outstanding liabilities	69.00
July 1, 1892, balance available	446.13
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	3,446.13
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	4,000.00

(See Appendix M 6.)

7. *Santee River, South Carolina.*—This river was obstructed by sunken logs and snags. The bar was narrow, crooked, and shifting, with only about 4 feet depth at low tide. The project provides for leaving the Mosquito Creek Canal, which has been completed for about $100,000 as a lumber route, and for a new cut between Estherville and Minim Creek at an estimated cost of $250,000, and for completely snagging the Santee River itself at a cost of $100,000. During the past year the flood gate in the Mosquito Creek Canal was completed. Dredging on the new canal continued, and the rice drainage injured by this cut has been restored, as required by the right of way. Up to June 30, 1892, $113,340.51 has been spent in giving a passage 30 feet wide and 5 feet deep at high water from Santee River to Winyah Bay, in building a drawbridge over Mosquito Creek, and in replacing damaged rice drainage. This year's commerce amounts to 110,523 tons.

July 1, 1891, balance unexpended	$26,890.88
June 30, 1892, amount expended during fiscal year	10,481.39
July 1, 1892, balance unexpended	16,409.49
July 1, 1892, outstanding liabilities	1,115.02
July 1, 1892, balance available	15,294.47
Amount appropriated by act approved July 13, 1892	30,000.00
Amount available for fiscal year ending June 30, 1893	45,294.47
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	290,000.00

(See Appendix M 7.)

8. *Wateree River, South Carolina.*—This river had a low-water depth of from 3 to 4 feet from its mouth 67 miles to Camden. It was much obstructed by snags and by two railroad bridges without draws. The project provides for 4-foot steamboat navigation to Camden. Total expenditures to June 30, 1892, $53,177.23.

The appropriation of September 19, 1890, completes the original estimated cost, and for this sum the river has been put into a satisfactory condition. The engineer in charge reports that an annual appropriation of $6,500 is needed for maintenance. This year's commerce amounts to 2,244 tons.

July 1, 1891, balance unexpended	$13,640.39
June 30, 1892, amount expended during fiscal year	6,817.62
July 1, 1892, balance unexpended	6,822.77
July 1, 1892, outstanding liabilities	462.64
July 1, 1892, balance available	6,360.13
Amount appropriated by act approved July 13, 1892	2,500.00
Amount available for fiscal year ending June 30, 1893	8,860.13

(See Appendix M 8.)

9. Congaree River, South Carolina.—This river had a low-water depth of from 3 to 4 feet from its mouth 48 miles to the railroad bridge at Columbia, thence 1 foot low-water depth 2 miles farther. The lower 47 miles from Granby to the mouth was blocked by snags, and a railroad bridge without a draw. The 3 miles above Granby was impassable, being rapids. The project provides for 4-foot navigation below Granby and a cleared channel through the rapids above. The work of the year has been snagging. Twenty thousand dollars has been spent to June 30, 1892, giving 4-foot navigation to Granby. This year's commerce amounts to 3,686 tons.

July 1, 1891, balance unexpended	$2,575.19
June 30, 1892, amount expended during fiscal year	2,575.19
Amount appropriated by act approved July 13, 1892	5,000.00
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	29,500.00

(See Appendix M 9.)

10. Charleston Harbor, South Carolina.—The work in progress since 1878 comprises two jetties of riprap with a mattress hearting wherever deemed advantageous, resting upon a mattress of logs and brush. The jetties spring from Sullivan and Morris islands and converge on curves so as to cross the bar on parallel lines about 2,900 feet apart. They are to establish and maintain a channel across the bar not less than 21 feet deep at low water, where heretofore the low-water depth has not exceeded 12 feet. Estimated cost for jetties up to low water $4,380,500; up to 3 feet above mean low water $5,334,500. Work continued under the contracts of Jacob Friday, and by hired labor. The contractor deposited 54,686 tons of stone at a cost to the United States of $114,990.89; by hired labor 53,641 tons of stone were deposited at a cost to the United States of $91,420.60. The cost per ton by contract was 40 cents greater than by hired labor.

Dredging began with the Government dredge, and 101,169 cubic yards of sand were removed between the 1st of August and the middle of February at a cost of 11½ cents per yard. Dredging was then suspended to put in a larger boiler, and at the close of the fiscal year the vessel was about ready to sail from New York and resume work.

No settlement of the jetties has occurred during the year.

About 1 mile of the south jetty and three-fourths of a mile of the north jetty have been raised to high water during the year, and some work below water has been done.

About 1,200 feet of breakwater has been built along the Mount Pleasant shore.

The annual survey shows marked deepening between the jetties and for some distance beyond their outer ends with a narrow shoal crossed by a narrow crooked 12-foot break outside. There is now but a few hundred feet between 15 feet of water at low tide inside and out. Total expenditures to June 30, 1892, $2,185,814.36.

July 1, 1891, balance unexpended	$308,052.39
June 30, 1892, amount expended during fiscal year	291,366.75
July 1, 1892, balance unexpended	16,685.64
July 1, 1892, outstanding liabilities	4,205.00
July 1, 1892, balance available	12,480.64
Amount appropriated by act approved July 13, 1892	225,000.00
Amount available for fiscal year ending June 30, 1893	237,480.64
Amount (estimated) required for completion of existing project	1,953,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	750,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M 10.)

11. Ashley River, South Carolina.—The plan of improvement comprised the removal of a shoal about 8 miles above the city of Charleston, S. C., where there was only 9 feet of water at low tide, and another just below the Wando Phosphate Works where there was only 6 feet. Low-water depths of from 10 to 11 feet with widths of from 100 feet to 200 feet have been obtained, and a balance is left for maintenance. This year's commerce amounts to 415,800 tons. Total expenditures to June 30, 1892, $4,673.66.

July 1, 1891, balance unexpended	$826.34
July 1, 1892, balance unexpended	826.34

(See Appendix M 11.)

12. Wappoo Cut, South Carolina.—The project provides for a channel 60 feet wide and 6 feet deep at low water between Ashley and Stono rivers. There is now a narrow 6-foot channel all the way through. This year's commerce amounts to 140,000 tons. Total expenditures to June 30, 1892, $40,416.77.

July 1, 1891, balance unexpended	$2,586.23
June 30, 1892, amount expended during fiscal year	3.00
July 1, 1892, balance unexpended	2,583.23
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	12,583.23
Amount (estimated) required for completion of existing project	35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M 12.)

13. Edisto River, South Carolina.—The river was much obstructed by snags and shoals. The project provides for a channel for rafts and flatboats from the sea, 260 miles, to Guignard Landing on the South Fork at an estimated cost of $33,385. The work of the year has been snagging. This year's commerce amounts to 132,580 tons. Total expenditures to June 30, 1892, $25,827.74.

July 1, 1891, balance unexpended	$4,193.25
June 30, 1892, amount expended during fiscal year	4,020.99
July 1, 1892, balance unexpended	172.26
Amount appropriated by act approved July 13, 1892	7,385.00
Amount available for fiscal year ending June 30, 1893	7,557.26

(See Appendix M 13.)

14. Salkahatchie River, South Carolina.—The river was much obstructed by snags. The project provides for a continuous flatboat channel from 5 miles above Toby Bluff to Hickory Hill at an estimated cost of $18,000. This year's commerce has amounted to 13,300 tons. The last appropriation completes the estimated cost and no further funds will be required, the improvement being completed and a sufficient balance being left for maintenance. Total expenditures to June 30, 1892, $13,482.93.

July 1, 1891, balance unexpended	4,524.80
June 30, 1892, amount expended during fiscal year	7.73
July 1, 1892, balance unexpended	4,517.07

(See Appendix M 14.)

15. Beaufort River, South Carolina.—The portion to be improved is near Coosaw River, where there was only about 4 feet depth at low water for a short distance. A through channel 7 feet deep has been provided by dredging as projected. The estimated cost is $25,000. The total expenditures to June 30, 1892, have been $9,584.95. The amount appropriated will be sufficient to give the channel the requisite width. This year's commerce amounts to 202,235 tons.

July 1, 1891, balance unexpended	$11,896.83
June 30, 1892, amount expended during fiscal year	8,981.78
July 1, 1892, balance unexpended	2,915.05
Amount appropriated by act approved July 13, 1892	12,500.00
Amount available for fiscal year ending June 30, 1893	15,415.05

(See Appendix M 15.)

16. Removing sunken vessels or craft obstructing or endangering navigation.—Three wrecks in the upper branches of the Cooper River were examined in June, 1892, and their removal was authorized by the Secretary of War.

(See Appendix M 16.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN GEORGIA, AND OF CUMBERLAND SOUND, GEORGIA AND FLORIDA.

Officer in charge, Capt. O. M. Carter, Corps of Engineers, with Lieut. Thomas H. Rees, Corps of Engineers, under his immediate orders; Division Engineer, Col. Wm. P. Craighill, Corps of Engineers.

1. Savannah Harbor, Georgia.—The plan of improvement under which operations have been carried on in Savannah Harbor during the last fiscal year was approved by the Secretary of War on July 22, 1890. The project contemplates the establishment of a navigable channel 26 feet deep at mean high water between the city of Savannah and Tybee Roads. The mean rise and fall of tides varies from about 7 feet at Fort Pulaski to about 6 feet in front of the city wharves.

The estimated cost of the improvement is $3,500,000.

In 1873, prior to improvement, the channel was in places not more than 9 feet deep at mean low water, and the usual high-water draft of vessels was not more than 14.5 feet.

Prior to July 1, 1891, there had been placed in the work, under the present project, 72,178.84 square yards of log and brush mattresses, 27,294.82 cubic yards of stone, 2,339 piles, and 25,825.57 cubic yards of brush fascines; and there had been removed from the channel, by dredging, 396,144.66 cubic yards of material.

During the fiscal year just closed 683.77 cubic yards of stone has been used in the oyster bed training wall. In the pile and brush work, forming the training walls below Spirit Island and the spur dams protecting the banks at Elba Island and Jones Island there have been used 934 piles, 28,969.01 cubic yards of brush fascines, and 1,604.46 cubic yards of stone. There were also driven 44 clusters of piles at the ends of the Jones Island and Elba Island spur dams.

Between the Ocean Steamship Company's wharves and Tybee Knoll 36,170.5 cubic yards of material have been removed by dredging. The expenditures during the year amounted to $133,322.39.

The total amount expended under the present project to June 30, 1892, including all outstanding liabilities, is $346,377.80.

There is now a navigable channel from the city to the sea with a least mean low-water depth of 14 feet, a gain of about 5 feet since the work was begun.

The real gain in navigable depth is somewhat greater than here shown, and vessels of from 20 to 21 feet draft now go from the city to the sea on a single tide.

The estimated reduction in freight rates, due to the improvements already executed, is 25 per cent, which effects an annual saving in freights alone of more than the total sum of money expended by the United States upon the harbor within the last 25 years.

July 1, 1891, balance unexpended	$141,886.14
June 30, 1892, amount expended during fiscal year	133,322.39
July 1, 1892, balance unexpended	8,563.75
July 1, 1892, outstanding liabilities	906.50
July 1, 1892, balance available	7,657.25
Amount appropriated by act approved July 13, 1892	318,750.00
Amount available for fiscal year ending June 30, 1893	$326,407.25
Amount (estimated) required for completion of existing project	2,831,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	1,000,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N 1.)

2. *Savannah River, Georgia.*—The present project for the improvement of this river was adopted in 1890, the object being to secure a low-water steamboat channel not less than 5 feet in depth between the cities of Augusta and Savannah, Ga.

The estimated cost of the improvement is $332,000. Prior to improvement navigation was much impeded by logs, snags, piles, and other obstructions. The depth at summer low water over some of the shoals did not exceed 2 or 3 feet.

The total amount expended under the present project to June 30, 1891, including all outstanding liabilities, was $7,411.24, and resulted in removing 354 snags, stumps, and logs and 3,443 overhanging trees from the most troublesome places throughout the whole extent of the river. Five trees were swung to bank and 24 logs were cut up on bank.

The expenditures during the year ending June 30, 1892, including all outstanding liabilities, amounted to $16,665.51.

Seven spur dams were constructed for the protection of caving banks below the city of Augusta, and some of the old dams were repaired. There were placed in the work 4,861.40 cubic yards of brush fascines and 3,352.47 cubic yards of stone. The increased depth of water over the shoals near Augusta has been maintained.

July 1, 1891, balance unexpended	$17,608.67
June 30, 1892, amount expended during fiscal year	16,665.51
July 1, 1892, balance unexpended	943.16
Amount appropriated by act approved July 13, 1892	35,000.00
Amount available for fiscal year ending June 30, 1893	35,943.16
Amount (estimated) required for completion of existing project	272,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N 2.)

3. *Darien Harbor, Georgia.*—The plan of improvement under which operations have been carried on in Darien Harbor during the last fiscal year was adopted in 1885. The project contemplates the establishment of a navigable channel 12 feet deep at mean low water between Darien and Doboy. The mean rise and fall of tide is about 6.5 feet.

The estimated cost of the improvement is $170,000.

No work was ever done under the existing project prior to the fiscal year ending June 30, 1891, during which the total amount expended, including all outstanding liabilities, was $4,870.49, resulting in the removal of 13,194.6 cubic yards of material from the worst shoal in the harbor.

The expenditures during the fiscal year just closed, including all outstanding liabilities, amounted to $22,431.24, and resulted in the removal by dredging of 73,445.6 cubic yards of material from the most troublesome shoals.

July 1, 1891, balance unexpended	$23,164.27
June 30, 1892, amount expended during fiscal year	22,431.24
July 1, 1892, balance unexpended	733.03
July 1, 1892, outstanding liabilities	55.00
July 1, 1892, balance available	678.03
Amount appropriated by act approved July 13, 1892	25,000.00
Amount available for fiscal year ending June 30, 1893	25,678.03
Amount (estimated) required for completion of existing project	120,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N 3.)

4. *Altamaha River, Georgia.*—The plan of improvement under which operations have been carried on upon the Altamaha River during the last fiscal year was adopted in 1890.

The project contemplates the establishment of a steamboat channel 3 feet in depth at ordinary summer low water between Darien and the junction of the Oconee and Ocmulgee rivers.

The estimated cost of the improvement is $129,000.

Prior to improvement navigation was much impeded by logs, snags, and other obstructions, the low-water depth at some points not exceeding 2 feet.

The total amount expended under the present project to June 30, 1891, including all outstanding liabilities, was $2,446.79, and resulted in removing many of the most dangerous snags and overhanging trees.

Five hundred and twenty-one snags and 1,011 overhanging trees were removed during the fiscal year 1892, and 8 logs were cut up. At Beards Bluff 1,231 linear feet of wattled pile spur dams were constructed, and the old training wall was repaired.

July 1, 1891, balance unexpended	$13, 276. 62
June 30, 1892, amount expended during fiscal year	6, 135. 96
July 1, 1892, balance unexpended	7, 140. 66
July 1, 1892, outstanding liabilities	286. 36
July 1, 1892, balance available	6, 854. 30
Amount appropriated by act approved July 13, 1892	15, 000. 00
Amount available for fiscal year ending June 30, 1893	21, 854. 30
Amount (estimated) required for completion of existing project	99, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N 4.)

5. *Oconee River, Georgia.*—The plan of improvement under which operations have been carried on upon the Oconee River during the last fiscal year was adopted in 1890.

The project contemplates the establishment of a steamboat channel 3 feet in depth at ordinary summer low water between Milledgeville and the mouth of the river.

The estimated cost of the improvement is $171,000.

Prior to improvement, navigation was much impeded by sand bars, overhanging trees, snags, and sunken logs. On some shoals there were low-water depths of not more than 2 feet. Under the present project, prior to July 1, 1891, 1,135 logs, snags, and stumps, and 146 overhanging trees were removed; 600 cubic yards of stone was placed in a closing dam at Fish Trap Cut; 19 piles were driven, and 11 brush mats sunk at Old Boat Yard, in constructing contracting works at that point.

The total amount expended under the present project to June 30, 1891, including all outstanding liabilities, was $8,120.31, and resulted in so improving the river that boats now run at a stage of water 4 feet lower than before improvements were begun.

During the fiscal year just closed the expenditures, including all outstanding liabilities, amounted to $14,283.30. There were removed from the channel 571 snags and stumps, 16,658 overhanging trees, and 366.5 cords of drift; 116 trees were girdled, and 166 logs were cut up.

In building spur dams at Old Boat Yard 13 snags and stumps were removed, 661 linear feet of brush mattresses was sunk, 146 piles were driven, and 935 linear feet of piling was wattled with poles. A new snagboat, the *Satilla*, was completed October 3, 1891.

July 1, 1891, balance unexpended	$17, 081. 12
June 30, 1892, amount expended during fiscal year	14, 283. 30
July 1, 1892, balance unexpended	2, 797. 82
Amount appropriated by act approved July 13, 1892	25, 000. 00
Amount available for fiscal year ending June 30, 1893	27, 797. 82
Amount (estimated) required for completion of existing project	121, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N 5.)

6. *Ocmulgee River, Georgia.*—The plan of improvement under which operations have been carried on upon the Ocmulgee River during the

last fiscal year was adopted in 1890. The project contemplates the establishment of a steamboat channel 3 feet in depth at ordinary summer low water between Macon and the mouth of the river.

The estimated cost of the improvement is $210,000.

Prior to improvement navigation was much impeded by rock shoals, sand bars, overhanging trees, snags, and sunken logs, the low-water depth at some places not exceeding 2 feet.

The total amount expended prior to June 30, 1891, including all outstanding liabilities, was $13,099.69, and resulted in removing many dangerous obstructions, boats now being able to run without accident at a stage of water some 3 feet lower than before the improvements were begun.

During the fiscal year just closed the expenditures, including all outstanding liabilities, amounted to $15,629.88. There were removed from the river 2,912 snags and stumps, and 6,756 overhanging trees; 19 trees were girdled, and 66 logs were cut up on the bank.

July 1, 1891, balance unexpended	$17,669.06
June 30, 1892, amount expended during fiscal year	15,629.88
July 1, 1892, balance unexpended	2,039.18
Amount appropriated by act approved July 13, 1892	25,000.00
Amount available for fiscal year ending June 30, 1893	27,039.18
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	155,000.00

(See Appendix N 6.)

7. *Brunswick Harbor, Georgia.*—The plan of improvement under which operations have been carried on in Brunswick Harbor during the last fiscal year was adopted in 1880, and modified and enlarged in 1886.

The project contemplates the establishment of a navigable channel not less than 15 feet deep at mean low water. The mean rise and fall of tide is 6.8 feet.

The cost of the project of 1880 was estimated at $73,187.50, and as enlarged in 1886 at $190,000, inclusive of appropriations already made.

In 1880, prior to improvement, the channel was not more than 9 feet deep at mean low water.

During the fiscal year just closed there was removed from the channel by dredging 49,324.3 cubic yards of material.

The amount expended to June 30, 1892, including all outstanding liabilities, is $161,694.86, and has resulted in securing a navigable low-water channel not less than 13.6 feet deep.

July 1, 1891, balance unexpended	$14,832.39
June 30, 1892, amount expended during fiscal year	13,950.35
July 1, 1892, balance unexpended	882.04
July 1, 1892, outstanding liabilities	76.90
July 1, 1892, balance available	805.14
Amount appropriated by act approved July 13, 1892	27,500.00
Amount available for fiscal year ending June 30, 1893	28,305.14

(See Appendix N 7.)

8. *Jekyl Creek, Georgia.*—The plan of improvement under which operations have been carried on in Jekyl Creek during the last fiscal year was adopted in 1888. The project contemplates the establishment

of a navigable channel through the creek 7 feet deep at mean low water. The mean rise and fall of tide is about 7.1 feet.

The estimated cost of the improvement is $38,590.

Prior to improvement the low-water depth at some places did not exceed 3 feet.

During the fiscal year just closed there was removed from the outer shoal, by dredging, 13,000 cubic yards of material.

The expenditures during the year, including all outstanding liabilities, amounted to $3,559.79. The total amount expended to June 30, 1892, including all outstanding liabilities, is $12,448.01, and has resulted in securing a navigable channel with a low-water depth of not less than 4.8 feet.

July 1, 1891, balance unexpended	$3,611.78
June 30, 1892, amount expended during fiscal year	3,559.79
July 1, 1892, balance unexpended	51.99
Amount appropriated by act approved July 13, 1892	7,500.00
Amount available for fiscal year ending June 30, 1893	7,551.99
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	18,590.00

(See Appendix N 8.)

9. *Cumberland Sound, Georgia and Florida.*—The plan of improvement under which operations have been carried on at Cumberland Sound during the last fiscal year was adopted in 1879, and revised in 1891. The project contemplates the establishment of a navigable channel across the bar 19 feet deep at mean low water. The mean rise and fall of tide is 5.9 feet. The estimated cost of the improvement is $2,079,500, exclusive of work done prior to 1891.

Prior to improvement the low-water depth of the entrance varied from 11 to 12.5 feet, with a mean rise and fall of tide of 5.9 feet.

During the fiscal year just closed there were placed in the north jetty 58,759.61 square yards of brush mattresses, 11,429.93 cubic yards of stone, extending the foundation course 5,146.5 feet. The total amount expended to June 30, 1892, including all outstanding liabilities, is $590,624.08.

July 1, 1891, balance unexpended	$108,173.78
June 30, 1892, amount expended during fiscal year	106,050.69
July 1, 1892, balance unexpended	2,123.09
July 1, 1892, outstanding liabilities	247.17
July 1, 1892, balance available	1,875.92
Amount appropriated by act approved July 13, 1892	170,000.00
Amount available for fiscal year ending June 30, 1893	171,875.92
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	1,817,500.00

(See Appendix N 9.)

10. *Removing sunken vessels or craft obstructing or endangering navigation.*—The wrecks of the steamers *Molton* and *St. Matthews*, in Darien Harbor, and of a large unknown vessel in Savannah Harbor, were, after due advertisement, removed by contract during the year.

(See Appendix N 10.)

EXAMINATIONS AND SURVEYS, MADE IN COMPLIANCE WITH PROVISIONS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *the inside route between Doboy and Sapelo (Sopelo), Georgia, with a view of making the same navigable for seagoing vessels*, was made by the local engineer in charge, Capt. (then Lieut.) Carter, and report thereon submitted through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division. In this report Capt. Carter, November 25, 1890, stated that the proposed route "forms a part of the inside route between Savannah, Ga., and Fernandina, Fla., and to that extent is worthy of improvement," but whether or not the locality is worthy of improvement to the extent contemplated by the act would depend upon the first cost and the probable cost of maintenance. These could not be determined with any degree of accuracy without a detailed survey and a thorough investigation of the tidal conditions in the locality. These views of the local officer being concurred in by the division engineer and by me, a survey was ordered and made, and report thereon submitted.

In the report on the survey Capt. Carter says:

> I am of the opinion that the "inside route between Doboy and Sapelo, Ga., with a view to making the same navigable for seagoing vessels," is not worthy of improvement.

The division engineer agrees with Capt. Carter in this opinion.

The reports were transmitted to Congress and printed as House Ex. Doc. No. 62, Fifty-second Congress, first session. (See also Appendix N 11.)

The required preliminary examinations of the following localities were made by the local engineer in charge, Capt. Carter, and reports thereon submitted through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division. It is the opinion of Capt. Carter, and of the division engineer, based upon the facts and reasons given, that these localities are worthy of improvement. The conclusions of these officers being concurred in by me, Capt. Carter was charged with and has completed their survey and submitted reports thereon. The reports were transmitted to Congress and printed as executive documents of the Fifty-second Congress, first session.

1. *The inside route between Savannah, Georgia, and Fernandina, Florida, with a view of obtaining a steamboat channel of 7 feet depth at mean low water.*—To establish a continuous channel not less than 7 feet deep at mean low water between Savannah, Ga., and Fernandina, Fla., will require dredging and other work of channel improvement at four points, Romerly Marsh, Mud River, Little Mud River, and Jekyl Creek. The cost of the work is estimated as follows:

Romerly Marsh (Habersham Creek route)	$53,000
Mud River	16,000
Little Mud River	1,000
Jekyl Creek (completion of existing project)	35,000
Total	105,000

The proposed improvements of Romerly Marsh and Mud River will require to be maintained after completion, and the annual cost of such maintenace is estimated as follows:

Romerly Marsh	$500
Mud River	4,000
Total	4,500

Capt. Carter states:

> Irregular and inadequate appropriations will greatly increase the cost of the work and delay its completion, and it is therefore recommended that unless the total sum required for its completion, viz, $105,000, can be appropriated at one time no appropriation for the work may be made.

Printed as House Ex. Doc. No. 41. (See also Appendix N 12.)

2. *Brunswick Outer Bar, Georgia, to determine the feasibility and cost of deepening the same to 26 feet at ordinary high water.*—The proposed improvement contemplates a chanel across the Outer Bar, opposite the entrance to St. Simon Sound, 300 feet wide and 26 feet deep at mean low water, to be obtained by the construction of two jetties and by dredging, the jetties extending eastwardly from St. Simon and Jekyl islands to points outside the bar, the least distance between the two jetties being 5,000 feet. The total cost of this work, in round numbers, is estimated at $2,700,000. Printed as House Ex. Doc. No. 34. (See also Appendix N 13.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN FLORIDA.

Officers in charge, Capt. W. M. Black, Corps of Engineers, to November 20, 1891, with Lieut. D. DuB. Gaillard, Corps of Engineers, under his immediate orders to November 6, 1891; and Maj. J. C. Mallery, Corps of Engineers, in charge since November 20, 1891; Division Engineer, Col. Wm. P. Craighill, Corps of Engineers.

1. *St. Johns River, Florida.*—Operations for the improvement of this river have been carried on in conformity with a project submitted in 1879 by the late Col. Q. A. Gilmore, Corps of Engineers. The plan contemplates the formation of a continuous channel 15 feet deep at mean low water from Jacksonville to the ocean. The points where work is required are in a reach near Dames Point, 12 miles from the mouth, and on the bar at the mouth. Near Dames Point the mean low-water depth varies from 12 to 13 feet, with a tidal range of about 2 feet. The bar at the mouth is formed of sand. Before work began the mean low-water channel depth across it varied from 5 to 7 feet, with a tidal range of 5.8 feet. The channel across the bar shifted continuously north and south through a mile range. The work was divided into two parts: (1) The formation of a channel across the bar at the mouth, by the concentration and direction of the tidal currents by two jetties, to start from the opposite shores of the entrance, and to converge, until, on the bar, their outer ends should be approximately parallel and 1,600 feet apart; and (2) the improvement of the Dames Point Reach, by dredging, and the construction of works of protection, under a project approved June 11, 1891, and approved in a modified form March 30, 1892.

As the improvement at the mouth was at first most urgently needed, the five appropriations up to that of 1886, inclusive, aggregating $675,000, were made for improving "the channel over the bar at the mouth," under the estimate for that part of the total project. Since 1887 the depth on the bar has been greater than that in the Dames Point Reach, and the interests of commerce have demanded that work at the latter point should be started. Accordingly, the appropriations since 1888 were made for improving the river "from Jacksonville to the ocean, including the channel over the bar at the mouth," under the estimate for the entire project. The work of improving the channel at Dames Point is now being carried out by means of an appropriation of $300,000 made by Duval County.

At the close of the fiscal year ending June 30, 1891, $865,146.99 had been expended. The south jetty had a total length of 7,147 feet. Of this 1,740 feet was built to the full height and capped; 4,680 feet was above mean low water excepting a few gaps at the outer end, and the depth over the remaining 727 feet sloped from mean low water to 13 feet below. The total length of the north jetty was 10,165 feet. Of this 553 feet was built to full height and capped; 6,514 feet was above mean low water excepting a few gaps. The average mean low-water depth across the remaining 3,098 feet was 5 feet. Prior to 1886 the jetties were built by alternate layers of mattresses and rock. Since that date mattresses have been used in the foundation course only. A survey of the Dames Point Reach was made in 1889 and a survey of the Mile Point Bank in 1892.

Work by contract under the appropriation of 1890 was continued. During the fiscal year 1891–'92 there were placed in the jetties 25,359 yards of mattresses, 28,577 tons of riprap stone, 1,343.4 cubic yards of shell, and 227.1 cubic yards of concrete. The south jetty foundation course has been extended 1,146 feet, and 920 feet of its superstructure raised to the level of mean low water. The north jetty foundation course has been extended 826 feet, 1,990 feet of its superstructure has been built to the level of mean low water, and 276 feet was capped with concrete blocks.

The southward movement of the south channel has continued. The depth over the outer bar is now about 12 feet, as against 13 feet last year. Over the inner bar it is now 15½ feet as against 11½ feet last year. The area of the 6-foot curve on the bank at the mouth of the jetties has diminished very much, and the bottom slope towards the sea has become generally steeper. The width of the bar across the North Channel has decreased from 700 feet to 300 feet, and there seems a possibility of temporarily using this channel pending the opening of the South Channel across the bank under the influence of the prolonged south jetty.

July 1, 1891, balance unexpended		$154,853.01
August 10, 1891, amount refunded by land-grant railroad		.88
		154,853.89
June 30, 1892, amount expended during fiscal year		93,448.41
July 1, 1892, balance unexpended		61,405.48
July 1, 1892, outstanding liabilities	$19,269.98	
July 1, 1892, amount covered by uncompleted contracts	24,982.00	
		44,251.98
July 1, 1892, balance available		17,153.50
Amount appropriated by act approved July 13, 1892		112,500.00
Amount available for fiscal year ending June 30, 1893		129,653.50

Amount (estimated) required for completion of existing project	284,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	284,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix O 1.)

2. *Ocklawaha River, Florida.*—The portion of the Ocklawaha River which it is proposed to improve, lies between Leesburg, on Lake Griffin, and the mouth, a distance of 94 miles. The channel width varies from 30 to 70 feet, and the depth from 5 to 9 feet. From the outlet of Lake Griffin, for a distance of 28 miles, the river is sluggish in current, has numerous bends, and is badly obstructed by floating islands and

grass. For the remaining 58 miles the current is strong and the principal obstructions are snags and overhanging trees.

The approved project is to clear the channel between Lake Griffin and the mouth by removing snags and the worst overhanging trees, and by moving the floating islands out of the channel and staking them in place by piles.

The amount expended on this improvement up to the close of the fiscal year ending June 30, 1891, was $2,455.68.

Under the appropriation made by act approved September 19, 1890, a survey and map of the river were made and the channel was cleared of its worst obstructions from the mouth to the prairie, a distance of 60 miles. A total of 3,881 snags and 705 overhanging trees were removed, and 84 trees were trimmed.

On account of the number of submerged snags being so greatly in excess of the estimate and the very low stage of the river, which prevented the boat going further up than the prairie, no work was done on the floating islands.

The unprecedented low water developed a few shoals which it appears desirable to have removed, and more effective means being proposed for keeping the channel clear of floating islands, the officer in charge recommends a further appropriation of $15,000 and subsequent annual appropriations of $1,000 for maintaining the channel.

July 1, 1891, balance unexpended	$7,544.32
June 30, 1892, amount expended during fiscal year	6,320.01
July 1, 1892, balance unexpended	1,224.31
July 1, 1892, outstanding liabilities	949.14
July 1, 1892, balance available	275.17
Amount appropriated by act approved July 13, 1892	1,000.00
Amount available for fiscal year ending June 30, 1893	1,275.17
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	6,510.90

(See Appendix O 2.)

3. *Volusia Bar, Florida.*—Volusia Bar is situated at the head of Lake George, and is formed by materials brought down by the St. Johns River and deposited at the point where the current of the narrow river loses its velocity as the bed widens to form the lake. The usual depth on the bar, before operations began, was from 3½ to 4½ feet, with a very crooked channel. At times this depth was diminished so much as to stop navigation entirely.

The adopted plan of improvement was to contract the waters on the bar by the construction of two converging jetties formed of brush and stone, with a view to causing a scour to the depth of 6 feet. Should the depth caused by the jetties not be sufficient, recourse was to be had to dredging. Between the jetties on the bar lines of guide piles were placed to keep vessels off the jetties and to define the channel clearly.

In 1887 it was decided to limit the channel depth sought to the 5 feet then obtained, on account of the evident shoaling in the lake beyond the jetties, and because that depth was sufficient for the requirements of the existing river commerce.

Up to June 30, 1891, $25,495.87 had been expended, including liabilities then outstanding. The jetties had been built to their full length and to a height sufficient to produce the desired effect; two lines of firmly set fender piles defined the jetty channel on the crest of the bar, and a straight channel with a minimum low-water depth of 5 feet had been obtained. In the spring of 1890 the crests of both jetties were found to have been lowered slightly, and several gaps had been made through them to a depth of 4 feet in one place. One hundred and ninety-seven cubic yards of rock was placed on the jetties, filling the lowest places.

In December, 1889, one of the river steamers broke out one of the panels of the west pile-fender line. This has not been repaired. During the past low-water season the channel depth at the end of the jetties fell to 4.6 feet, and commerce was greatly delayed. The officer in charge reports that on account of the shoalness of the lake beyond the jetties any further increase of depth should be attained by dredging from time to time, as may be required. He states that this will require an annual outlay of $500, provided a contract can be made for the work. As it is very difficult to obtain dredging plant in this vicinity he recommends the construction of a suitable dredge for use here and in the Upper St. Johns River (for the improvement of which there remains an unexpended appropriation of $4,930), at a cost of $15,000.

July 1, 1891, balance unexpended	$504.13
June 30, 1892, amount expended during fiscal year	394.04
July 1, 1892, balance unexpended	110.09
Amount appropriated by act approved July 13, 1892	1,000.00
Amount available for fiscal year ending June 30, 1893	1,110.09
Amount (estimated) required annually for maintenance of existing project	1,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix O 3.)

4. *St. Augustine Harbor, Florida.*—The approved project is to protect the shores from erosion by the construction of groins of concrete and riprap on brush foundation mattresses.

Two appropriations, aggregating $55,000, have been made for this harbor and have been expended in accordance with this project.

Work under the first appropriation was begun in October, 1889, and ended in September, 1890.

Work under the second appropriation was commenced in December, 1890, and ended in May, 1891.

The amount expended up to June 30, 1891, was $50,887.88.

Five groins in all have been built; one 341 feet long and another 523½ feet long, on Anastasia Island, near the light-house; one 548.9 feet long, one 465 feet long, and one 415 feet long, on North Beach, near the point.

During the year a sheet pile wing dam 327 feet long was built on the south side of Groin No. 4.

The shore lines have continued to build out excepting in the vicinity of Groin No. 4 and on the west side of Groin No. 2, where slight erosions have taken place.

July 1, 1891, balance unexpended	$4,112.12
June 30, 1892, amount expended during fiscal year	2,832.52
July 1, 1892, balance unexpended	1,279.60
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	11,279.60

(See Appendix O 4.)

5. *Northwest entrance, Key West Harbor, Florida.*—A bar having a channel depth of 10.5 feet obstructs the northern entrance to this harbor. During storms the available depth is so much reduced that vessels bound to and from Gulf ports can not use it, but are compelled to make a detour of about 100 miles by Dry Tortugas to enter or leave the Gulf.

An examination of the entrance, with a view to its improvement, was made in 1867 and again in 1881. In 1882 Congress made an appropriation of $25,000 for dredging a channel 300 feet wide and 17 feet deep across the bar. As was anticipated, the improvement was only temporary.

In the act approved August 5, 1886, $2,500 was appropriated for a new examination and survey of the bar. This was made in December, 1886, and January, 1887. The bar was found to be formed and maintained by interfering tidal currents. The project for its improvement comprised the construction of one or more training walls, with dredging, if necessary.

In the act of August 11, 1888, Congress appropriated $25,000 for this work, with the proviso that the Secretary of War should appoint a board of three engineer officers, who should consider the subject and report on the advisability of continuing the work under the above project, and that he should submit the report, together with the views of himself thereon, to Congress at its next session.

The final report of the Board was submitted in November, 1889, and printed as a part of Appendix P 4, Report of the Chief of Engineers, 1890. The Board was of the opinion that the work is of national importance. It recommended that the improvement be begun by the immediate construction of a jetty along the northeast side of the entrance.

Up to the close of the fiscal year ending June 30, 1891, $9,087.67 had been expended on the present project.

Work under the appropriation of 1890 was continued until May 12, 1892, when the contract was completed. Twenty-six thousand eight hundred and twenty-one and nine-tenths cubic yards of stone was placed in the jetty during the fiscal year ending June 30, 1892, making a total of 27,982.2 cubic yards now in the jetty.

The jetty has a total length of 6,888 feet, with an average width at the base of 25 feet and an average crest width of 10 feet, with a depth over it at mean low water varying from 2.5 to 10 feet, and averaging 5.5 feet.

A deepening has occurred between the jetty and the main channel across the bar, producing a channel of a least width of 400 feet and a least mid-channel depth of 11 feet. The depth in the main channel across the bar has increased from 11.8 feet in 1889 to 12.5 feet.

July 1, 1891, balance unexpended	$55,912.33
June 30, 1892, amount expended during fiscal year	55,793.73
July 1, 1892, balance unexpended	118.60
July 1, 1892, outstanding liabilities	25.00
July 1, 1892, balance available	93.60
Amount appropriated by act approved July 13, 1892	75,000.00
Amount available for fiscal year ending June 30, 1893	75,093.60
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	385,000.00

(See Appendix O 5.)

6. *Caloosahatchee River, Florida.*—Before improvement the lower part of the river was so obstructed by oyster bars that the available channel depth was only 5½ feet. About 17 miles above the mouth the river loses the characteristics of an estuary, and there are numerous islands and a broad shoal.

The project adopted in 1882 called for the formation, by dredging, of a channel 100 feet wide and 7 feet deep from the bay to Fort Myers, a distance of 17 miles. In 1886 this project was modified so as to include the improvement of the upper river as far as Fort Thompson by removal of snags and overhanging trees.

Up to June 30, 1891, $27,453.39 had been expended on the improvement. A channel 6 feet deep and 100 feet wide existed between the mouth and Fort Myers. A narrow cut, 5 feet deep, had been made through the shoals at Beautiful Islands and partially protected by a training wall, and the worst obstructions had been removed from the river as far as Fort Thompson.

Three thousand six hundred dollars was appropriated in the act of September 19, 1890, for completing the improvement. With this sum the remaining obstructions were removed from the channel between Fort Thompson and the Beautiful Islands. The cut at the Beautiful Islands shoal and its protecting dike were extended, and the channel through the oyster bars at the mouth of the river was enlarged and marked. When work stopped there was a clear channel from the mouth to Fort Thompson, having a mean low-water depth of 6 feet as far as Fort Myers and a depth of 4 feet for the remaining distance. An annual expenditure of $1,000 will be required to maintain this improvement.

July 1, 1891, balance unexpended	$146.61
August 10, 1891, amount refunded by land-grant railroad	3.63
	150.24
June 30, 1892, amount expended during fiscal year	127.65
July 1, 1892, balance unexpended	22.59
Amount appropriated by act approved July 13, 1892	1,000.00
Amount available for fiscal year ending June 30, 1893	1,022.59
Amount (estimated) required for maintenance of existing project Submited in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	1,000.00

(See Appendix O 6.)

7. *Channel of Charlotte Harbor and Pease Creek, Florida.*—The portion under improvement lies between the Boca Grande entrance from the Gulf of Mexico and the wharves at Punta Gorda, 2 miles from the mouth of Pease Creek. The available depth at the entrance is 19 feet at mean low water. Immediately within the entrance there is an anchorage with a depth of 18 feet and over. Between that point and Punta Gorda, a distance of 24½ miles, the channel depth varies from 10 to 20 feet. In the act of September 19, 1890, $35,000 was appropriated for improving the channel between the limits named. A survey of the defective portions of the channel was made, a project was prepared for its improvement, and a contract entered into for doing the work. The approved project contemplates the immediate formation of a channel 12 feet deep and as wide as the funds will permit. The estimated cost of a channel 200 feet wide and 12 feet deep is $127,500; of a channel 200 feet wide and 15 feet deep, $468,000.

The amount expended up to June 30, 1891, was $2,886.44.

It was decided to expend the money available in deepening the channel from the wharf at Punta Gorda to Beacon No. 2, a distance of about 10,000 feet. The present depth of water in this portion of the channel varies from 10 feet at the wharf to 12 feet at Beacon No. 2. It is estimated that the amount available is sufficient to excavate a channel 300 feet wide for a distance of 300 feet in front of the wharf, and 100 feet wide from that point to Beacon No. 2 to a depth of 12 feet.

Active operations will begin as soon as the contractor has completed the work in Hillsboro Bay, Florida.

July 1, 1891, balance unexpended	$32,113.56
June 30, 1892, amount expended during fiscal year	337.51
July 1, 1892, balance unexpended	31,776.05
July 1, 1892, amount covered by uncompleted contracts	29,500.00
July 1, 1892, balance available	2,276.05
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	92,500.00

(See Appendix O 7.)

8. *Sarasota Bay, Florida.*—The total length of Sarasota Bay is 34 miles. The portion under improvement extends from Tampa Bay to Sarasota, a distance of 21¼ miles. The general available channel depth is 5 feet, but there are two reaches, aggregating 1 mile in length, where the available channel depth varies from 3.5 to 4.3 feet. The approved project contemplates the formation of a channel 100 feet wide and 5 feet deep at mean low water between the limits named above.

The amount expended up to June 30, 1891, was $273.00.

Work was begun by the United States snag and dredge boat *Suwanee* October 31, 1891, and discontinued, owing to the exhaustion of the appropriation, February 13, 1892. The work was much retarded by stormy weather and accidents to the pump dredge, caused by its being choked with large clams, some of which were as much as seven inches in diameter. 4,363.5 cubic yards of material, measured in place, were removed, forming a cut 1,673 feet long and 38 feet wide through the shoal near Palma Sola Point.

July 1, 1891, balance unexpended	$4,727.00
June 30, 1892, amount expended during fiscal year	4,666.73
July 1, 1892, balance unexpended	60.27
Amount appropriated by act approved July 13, 1892	2,500.00
Amount available for fiscal year ending June 30, 1893	2,560.27
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	10,000.00

(See Appendix O 8.)

9. *Manatee River, Florida.*—The portion of the Manatee River under improvement is the lowest reach, between Rocky Bluff and the mouth, a distance of about 12 miles. This had a midchannel depth of from 7 to 20 feet. The general width is about three-fourths of a mile. At the mouth was a long shoal with a minimum depth of 7 feet. Between Palmetto and Manatee, about 6 miles from the mouth, was another bar, covered by from 3 to 5 feet of water.

The river was examined in 1881. The project adopted had for its object to form a channel 100 feet wide and 13 feet at mean low water from Tampa Bay to McNeil Point (Palma Sola). Owing to the changed commercial relations since the adoption of the project, brought about by the extension of the railroad to Tampa, the transfer to Tampa of the principal Gulf steamship lines, and the service of the smaller towns around Tampa Bay by coasting steamers from Tampa, the project was modified in 1886 to provide for the passage of these lighter-draft vessels to all of the towns of the lower river by the removal of the bar above Palmetto.

Up to the close of the fiscal year ending June 30, 1891, $27,881.93 was expended on this improvement. A dredged cut was made across the bar at the mouth of the river, another cut was made across the bar between Manatee and Braidentown, and a survey and map of the river were made. The cut at the mouth had been nearly obliterated, but a channel 8 feet deep and of sufficient width existed from Tampa Bay to Manatee. In the act approved September 19, 1890, $6,000 was appropriated for continuing the improvement. The amount was insufficient to make any permanent improvement in the channel at the mouth, the only place where work is now required, and the money available is held until required elsewhere in the river or until further appropriations shall increase it to a sum sufficient for economical work at the mouth.

July 1, 1891, balance unexpended	$6,118.07
June 30, 1892, amount expended during fiscal year	96.20
July 1, 1892, balance unexpended	6,021.87
July 1, 1892, outstanding liabilities	46.35
July 1, 1892, balance available	5,975.52
Amount appropriated by act approved July 13, 1892	6,000.00
Amount available for fiscal year ending June 30, 1893	11,975.52
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	33,000.00

(See Appendix O 9.)

10. Tampa Bay, Florida.—The harbor at Tampa Bay, at the head of one arm of this bay, was separated from deep water by a flat 2 miles wide. Through this was a narrow channel with an average available depth of about 5 feet, formed by the waters of Hillsboro River.

The original project was adopted in 1879, and had for its object the formation of a 9-foot channel, 150 feet wide in the bay and 200 feet wide in the river, from the 9-foot curve in the bay to the wharves at Tampa, in Hillsboro River, at an estimated cost of $97,000.

Up to June 30, 1891, $95,194 had been expended. The work consisted entirely of dredging and rock excavation, and extended over a distance of 8,200 feet, making a cut varying in width from 200 feet in the river to 60 feet in the bay. On June 30, 1887, it had a depth along its center line of from 8.3 to 9 feet. The depth on the flats beyond the outer extremity of the cut is 7 feet. In 1888 the project was modified. Port Tampa, 9½ miles from Tampa, on Old Tampa Bay, had become the deep-water port of Tampa. The modified project is to form and maintain a channel 8 feet deep in Hillsboro Bay and Hillsboro River to the city of Tampa, and a channel 20 feet deep and 200 feet wide from the outer bar to Port Tampa.

Up to June 30, 1891, no further work had been done in Hillsboro Bay.

In Old Tampa Bay the channel through the outer bulkhead had been dredged to a depth of 20 feet for a width of 100 feet, and from 16 to 20 feet for the remaining 100 feet in width, and that through the inner bulkhead for a width of 150 feet with a mid-depth of 19.7 feet.

By the act approved September 19, 1890, $25,000 was appropriated for continuing the improvement.

Under this appropriation work was resumed in Old Tampa Bay December 19, and in Hillsboro Bay April 7. The channel called for by the project was completed in Old Tampa Bay May 12. Work still continued in Hillsboro Bay at the end of the fiscal year. On June 30 a continuous channel 8 to 9 feet deep and 70 feet wide had been secured from the mouth of the Hillsboro River to the 8-foot contour in Hillsboro Bay, near Ballast Point. In a bend in the channel near Spanish Town Point the channel has been made 100 feet wide.

July 1, 1891, balance unexpended		$24, 806. 00
June 30, 1892, amount expended during fiscal year		14, 801. 36
July 1, 1892, balance unexpended		10, 004. 64
July 1, 1892, outstanding liabilities	$5, 327. 59	
July 1, 1892, amount covered by uncompleted contracts	4, 080. 67	
		9, 408. 26
July 1, 1892, balance available		596. 38
Amount appropriated by act approved July 13, 1892		10, 000. 00
Amount available for fiscal year ending June 30, 1893		10, 596. 38

(See Appendix O 10.)

11. Withlacoochee River, Florida.—This river is 120 miles long and has a normal width varying from 75 to 180 feet, though at numerous points a defined channel is almost lost in broad marshy lakes and cypress swamps. The low-water depth varied from 1 to 7½ feet. Before improvement the river was so obstructed by shoals, loose rocks, snags, fallen trees, floating-grass islands, and bars as to be practically impassable excepting in isolated reaches.

The river was examined with a view to its improvement in 1879. The approved project calls for the removal of snags, overhanging trees, loose rocks, and some of the worst shoals between the Gulf of Mexico and Pemberton Ferry, a distance of about 77 miles, so as to permit boats of 2 feet draft to navigate the river during one-half the year.

Prior to June 30, 1891, the river had been cleared and made navigable as called for by the project between Pemberton Ferry and Dunnellon. Work was still required on some of the ledges in order to make navigation safe. Work was also required below Dunnellon.

The amount expended up to June 30, 1891, was $17,859.83.

In the act approved September 19, 1890, $5,400 was appropriated for continuing the improvement. Work under this appropriation was begun March 23 and still continued June 30. On account of the very low stage of the river the United States snag and dredge boat *Suwanee* could not be taken up where the work was most required. The boat was laid up and a party formed from the crew and the work of removing obstructions was carried on from the small boats and from the banks; 79 snags and 10 overhanging trees were removed; 465 cubic yards of rock was blasted and 296 cubic yards of rock was removed from the channel; 128 linear feet of dams was built.

The channel called for by the project is nearly completed.

July 1, 1891, balance unexpended	$6,040.17
August 10, 1891, amount refunded by land-grant railroad	3.57
	6,043.74
June 30, 1892, amount expended during fiscal year	3,193.00
July 1, 1892, balance unexpended	2,850.74
July 1, 1892, outstanding liabilities	762.74
July 1, 1892, balance available	2,088.00

(See Appendix O 11.)

12. *Harbor at Cedar Keys, Florida.*—The improvement of this harbor has been carried on from time to time under various appropriations made since 1872. It was obstructed by a shoal, known as the Middle Ground, lying in the Main Ship Channel opposite War Key and by shoals elsewhere in the channel and at its outer extremity. At these points the general channel depth of 12 feet was reduced from 7 or 9 feet by outcropping rocks with sand and shells.

The existing project for the improvement has for its object to form a channel 200 feet wide and 10½ feet deep through these shoals. Work under this project has been carried on under various appropriations made since 1884. The total expenditure up to June 30, 1891, was $19,852.92. A clear channel of the required depth from the Gulf up to Cedar Keys had been obtained. Near Buoy No. 12 and in the Middle Ground the width was insufficient. Some further dredging was done in the Middle Ground. When work stopped the cut there had a width of 200 feet and a least depth of 9½ feet. Along its east side the depth was 10 feet. In the act approved September 19, 1890, $2,500 was appropriated for this harbor, with the provision that a portion could be expended at Derrick Island Gap on the inside channel from Suwanee River. The project for this portion of the improvement is to obtain a channel 5 feet deep at mean low water from the harbor of Cedar Keys to the Suwanee Basin.

The work was done with the United States steam snag and dredge boat *Suwanee.* When operations ceased, owing to the exhaustion of the appropriation, a channel had been dredged in the vicinity of Derrick Island Gap 1,196 feet long, 37½ feet wide, and 6 feet deep.

July 1, 1891, balance unexpended	$2,147.08
June 30, 1892, amount expended during fiscal year	1,941.17
July 1, 1892, balance unexpended	205.91
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	44,000.00

(See Appendix O 12.)

13. *Suwanee River, Florida.*—The length of river under improvement is 130 miles. From the Derrick Gap entrance to Branford, a distance of 80 miles, the width of the river varies from 250 to 300 feet, and its original low-water depth from 3 to 30 feet. It was but little obstructed, excepting at the mouth. Between Branford and Ellaville the general width is 325 feet. It was obstructed by many dangerous rock shoals, crossed by crooked channels, which had a low-water depth of from 1.5 to 3 feet, as well as by snags and overhanging trees.

A project for this improvement was adopted in 1880. It contemplates the formation of a channel 150 feet wide and 5 feet deep from the gulf (through the bars at the passes) as far up the river as New

Branford (Roland Bluff). From there to Ellaville the channel is to be 60 feet wide and 4 feet deep.

Up to the close of the fiscal year ending June 30, 1891, $39,677.07 had been expended on this improvement. A long cut, now partly obliterated, had been made through the shoals between the mouth and deep water of the Gulf of Mexico, and a practicable but not safe channel had been opened as far as Hudson.

During the past fiscal year operations have been carried on by the United States snag boat *Suwanee*, and the channel between Branford and Luraville has been widened and deepened so that a channel safe during medium and high stages, and fairly safe and 3 feet deep at the lowest stages, now exists as far as Hudson, 15 miles below Ellaville. The channel across the Suwanee Basin was partially opened and was marked with palmetto piles.

July 1, 1891, balance unexpended	$1,322.93
August 10, 1891, amount refunded by land-grant railroad	.55
	1,323.48
June 30, 1892, amount expended during fiscal year	1,085.15
July 1, 1892, balance unexpended	238.33
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	3,238.33
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	21,158.00

(See Appendix O 13.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN GEORGIA, FLORIDA, AND ALABAMA.

Officer in charge, Capt. Philip M. Price, Corps of Engineers, with Lieut. William E. Craighill, Corps of Engineers, under his immediate orders; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Apalachicola Bay, Florida.*—In 1879 there was a minimum depth of 3½ feet in the channel over the bar at the mouth of the Apalachicola River.

The bar begins about one-half mile below the town of Apalachicola, Fla., and is about 7,300 feet wide.

In 1879 a plan of improvement was adopted which contemplated dredging through the bar a straight channel 11 feet deep and 100 feet wide, to be afterwards increased to 200 feet wide should the first cut produce results to warrant it.

In 1891 this project was amended to include dredging a straight channel through Bulkhead Shoal 9 feet deep and not less than 100 feet wide.

Up to June 30, 1891, the sum of $88,539.01 had been expended on this improvement in dredging a straight channel through the bar at the mouth of the river, whenever funds were available, between the years 1881 and 1890. On account of inadequate appropriations the dredged cut has never exceeded 90 feet in width and 9½ feet in depth, and has gradually filled up, partly by the deposit of silt from the river and partly by the washing in of material from the sides of the cut by the currents produced by the tides and the prevailing easterly winds.

During the fiscal year ending June 30, 1892, $18,412.31 has been expended. Under the contract with the Alabama Dredging and Jetty

Company, approved August 3, 1891, 54,458 cubic yards of material was dredged on Bulkhead Shoal, between October 26, 1891, and February 6, 1892, at 25 cents per cubic yard. A straight cut was made about 4,000 feet long, 9 feet deep and 120 feet wide. Between February 6 and 27, 1892, 11,461 cubic yards of material was dredged from the shoalest places in the straight channel over the bar at the mouth of the Apalachicola River, when further operations were suspended on account of exhaustion of funds.

It is anticipated that the cut through Bulkhead Shoal may be reasonably permanent. Experience has shown that the channel through the bar at the mouth of the river will require redredging at least once in two years, unless the cut is made deeper and wider than has been hitherto possible with the funds available. It is probable that a deeper and wider cut may be more lasting.

July 1, 1891, balance unexpended	$18,461.24
June 30, 1892, amount expended during fiscal year	18,412.31
July 1, 1892, balance unexpended	48.93
July 1, 1892, outstanding liabilities	13.50
July 1, 1892, balance available	35.43
Amount appropriated by act approved July 13, 1892	20,000.00
Amount available for fiscal year ending June 30, 1893	20,035.43

(See Appendix P 1.)

2. *Apalachicola River, Florida.*—The examination and survey of the Apalachicola River, finished in 1873, showed that the river, throughout its length of 105 miles, had a natural channel not less than 6 feet deep. The channel was, however, much obstructed by the accumulation of logs and snags brought into it by the freshets in the Chattahoochee and Flint rivers. At Moccasin Slough the river had been obstructed by piles, driven by Confederate authorities during the war. Drift logs had accumulated against these piles, and formed a dam across the river, and forced a narrow and very crooked channel through its banks into the river Styx. Navigation was difficult at the Upper and Lower Elbows on account of the abrupt bends and narrow channel.

The original project for the improvement of the river provided for securing a channel, 100 feet wide and 6 feet deep, by the removal of snags and overhanging trees, and widening and straightening the channel at Moccasin Slough and the Elbows, at an estimated cost of $80,333.

In conformity with the act of September 19, 1890, this project was in that year modified by adding thereto the securing of a channel 60 feet wide and 5 feet deep, through the Cut-Off, Lee Slough, and the Lower Chipola River, at an estimated cost of $7,500.

The expenditure, from 1874 to June 30, 1891, of $43,811.43, had resulted in clearing out the great accumulation of logs and snags and overhanging trees, and in annually removing the logs and snags brought down by the freshets in the rivers above.

A partial improvement had also been effected at Moccasin Slough and the Elbows, but navigation at these points was still difficult.

A little work had been done on the Cut-Off and Lower Chipola River, in order to enable steamboats to reach the landings above and below Lee Slough, but the funds available had not been sufficient to do any work on Lee Slough itself.

During the fiscal year ending June 30, 1892, the sum of $754.47 has been expended in removing the snags, sunken logs, and overhanging trees from the Apalachicola River, and from the Cut Off and Lower Chipola River, which lead to Lee Slough. The country bordering on Lee Slough is now attracting the attention of settlers, and would be rapidly developed if the Cut-Off and Lee Slough and Lower Chipola River were so cleared of obstructions that the river steamboats could get through them on their regular trips. The river affords the only practicable means of transportation for the products of this country.

July 1, 1891, balance unexpended	$754.47
June 30, 1892, amount expended during fiscal year	754.47
Amount appropriated by act approved July 13, 1892	5,000.00

(See Appendix P 2.)

3. *Flint River, Georgia.*—Before the improvement was begun the river was only navigable at low water from its mouth up to Bainbridge, and the channel over this portion was narrow, crooked, and much obstructed by logs, snags, and overhanging trees.

The present project for the improvement of this river was adopted in 1873 and modified in 1879, the object of the original project being to afford a channel 100 feet wide and 3 feet deep at low water from its mouth up to Albany, Ga., an estimated distance of 105 miles; and of the modification, to provide a navigable channel for light-draft steamers, at moderate stages of water, from Albany to Montezuma, an estimated distance of 77 miles.

Previous to the act of June 18, 1878, $70,000 was appropriated for the "Chattahoochee and Flint rivers," of which $18,000 was expended on the Flint River.

The expenditure up to June 30, 1891, of $140,220.84, had resulted in obtaining a navigable channel, having a low-water depth of 3 feet, from the mouth of the river to Albany. Above Albany the river had been partially cleared of logs and snags, and, to a limited extent, of loose rock, between Albany and Montezuma.

During the fiscal year ending June 30, 1892, $12,080.74 was expended in the care and preservation of plant and in continuing work under the approved project.

Between the mouth of the river and Bainbridge, Ga., the river is in a fairly navigable condition, and only requires the annual clearing out of snags brought in by the winter freshets.

Between Bainbridge and Albany, Ga., a channel having a low-water depth of 3 feet and a minimum width of 50 feet has been secured, but in many places this channel is too narrow and tortuous for safe navigation, and will be improved as funds are available. The work will consist in drilling, blasting, and removing rock from the marl and rock shoals. When completed the improvement will be comparatively permanent; but, for the preservation of the improvement, it will be necessary to maintain a snag boat on the river, at an annual cost of $6,000.

Between Albany and Warwick, 38 miles above, low-water navigation is prevented by a series of rock shoals, on which the depth of water varies from 6 to 18 inches. The loose bowlders have been partially removed from the channel on this portion of the river.

Between Warwick and Montezuma the improvement consists mainly in the removal of logs and snags and overhanging trees, and has been sufficiently accomplished to permit navigation at moderate stages of water. Fresh logs and snags will, however, be brought in by each winter's freshets. So far as known no commercial use has been made of the river above Albany since July, 1890, when the Montezuma Steamboat Company sold their small steamer to the Albany Navigation Company, which has since used it on the river below Albany. There are no indications that any use will be made of the river above Albany in the near future. For this reason no measures have been yet taken to require the owners of the two bridges, which now obstruct navigation, at distances of 16 and 41 miles respectively above Albany, to provide their bridges with draw openings.

Between Albany and Bainbridge a considerable river trade has been developed in consequence of the improvements already effected. The business will be much increased as low-water navigation is facilitated by further work.

Between Bainbridge and the mouth of the river the many steamboats plying on the Chattahoochee and Apalachicola rivers run regularly and do a large business.

July 1, 1891, balance unexpended	$16,809.17
June 30, 1892, amount expended during fiscal year	12,080.74
July 1, 1892, balance unexpended	4,728.43
July 1, 1892, outstanding liabilities	794,81
July 1. 1892, balance available	3,933.62
Amount appropriated by act approved July 13, 1892	15,000.00
Amount available for fiscal year ending June 30, 1893	18.933.62

(See Appendix P 3.)

4. *Chattahoochee River, Georgia and Alabama.*—The river was originally much obstructed by logs, snags, and overhanging trees, and by a number of rock and marl shoals and sand bars, so that navigation was difficult and dangerous. Steamboats could only run by daylight, and not unfrequently lay on sand bars for weeks at a time, waiting for a rise in the river. Very many were lost by striking logs and snags.

The present plan of improvement, adopted in 1873 and modified in 1882, contemplates a low-water channel 4 feet in depth and 100 feet in width from Columbus, Ga., to Chattahoochee, Fla., a distance of 224 miles, by the removal of snags and other obstructions from the channel and overhanging trees from the banks; by the excavation of rock shoals, and by works of contraction and shore protection.

Previous to the act of June 18, 1878, $70,000 was appropriated for the "Chattahoochee and Flint rivers," of which $52,000 was expended on the Chattahoochee River.

The expenditure of $251,941.23, up to June 30, 1891, has resulted in securing and maintaining a fair navigable channel between Chattahoochee, Fla., and Eufaula, Ala., at all seasons of the year, and between Eufaula, Ala., and Columbus, Ga., at all times except during low water.

Steamboats now make regular trips, with but few detentions, running by night as well as by day.

The limited annual appropriations for this improvement have not been sufficient to maintain properly the works of contraction already constructed, nor to extend nor modify them as required.

During the year ending June 30, 1892, $9,604.64 has been expended in maintaining the existing improvement, excavating rock shoals, and in making a partial improvement at Mound Bar, by contraction and shore protection works. The most serious obstructions are now at the Mound and Woolfolks bars, between Eufaula and Columbus, Ga. At both these places the banks are caving badly, and navigation is yearly becoming more difficult and dangerous. At low stages boats have to be warped over the bars. Trouble is also experienced at Francis Bend, above Eufaula, and Kings Rock, about 200 miles below Columbus.

If sufficiently large appropriations were made to permanently improve these localities, it is believed that thereafter the navigation of the river could be maintained in good condition throughout the year, by annual appropriations of $10,000, for the repair and maintenance of the plant and improvements, and for the removal of the annual accumulation of logs and snags brought in by the winter freshets.

The hull of the snag boat *Chattahoochee* is nearly worn out, and is not worth repairing further. The snag boat will have to be practically rebuilt, at an estimated cost of $10,000.

Regular lines of steamboats do a large passenger and freight business on this river, which affords the only practicable means of transportation to a considerable section of country.

July 1, 1891, balance unexpended	$11,076.98
June 30, 1892, amount expended during fiscal year	9,604.64
July 1, 1892, balance unexpended	1,472.34
July 1, 1892, outstanding liabilities	373.29
July 1, 1892, balance available	1,099.05
Amount appropriated by act approved July 13, 1892	25,000.00
Amount available for fiscal year ending June 30, 1893	26,099.05

(See Appendix P 4.)

5. *La Grange Bayou and Holmes River, Florida.*—La Grange Bayou is situated on the north side and near the head of Choctawhatchee Bay, and into it flows Cedar Creek, a deep stream from 90 to 160 feet wide, on which is situated the town of Freeport, 1½ miles above the bayou.

The channel though the bayou was originally narrow and shoal, and obstructed by logs and drift.

An examination of the bayou was made under the act of Congress approved March 3, 1881, and an estimate submitted for dredging the channel, so as to admit the passage of vessels drawing 4½ feet at mean low water, at a cost of $19,994.30.

In 1883 the sum of $2,000, allotted from the appropriation of $20,000, made by the act of August 2, 1882, for the improvement of Choctawhatchee River, Florida, was expended on La Grange Bayou, mainly in removing snags and drift, and in dredging a small amount of mud from the shoalest part of the channel. Since then no work has been done.

The act of August 5, 1886, appropriated $2,000 for this improvement. So small a sum could not be profitably expended, and it was decided to withhold it until an additional appropriation was made for the work.

The act of August 11, 1888, appropriated $3,000 for completing the improvement of La Grange Bayou, including Holmes River, up to the town of Vernon.

An examination and partial survey, made in 1889, showed that the amount of $5,000, then available for the improvement, was not sufficient to complete it as required by the act, and the Secretary of War therefore directed that no further expenditures should be made.

Before the completion of the Pensacola and Atlantic Railroad the town of Freeport was the center of trade for a large section of country surrounding it. This trade was mainly carried on in vessels plying between Pensacola and Freeport.

Since the completion of the railroad, however, the commerce of Freeport and La Grange Bayou has diminished to such an extent that in 1889 there was only one store in Freeport, and but one schooner made occasional trips between that point and Pensacola.

No necessity now appears to exist for the further improvement of La Grange Bayou, Florida.

The act of September 19, 1890, appropriated $3,000 for "improving La Grange Bayou, continuing improvement of Holmes River, Florida."

Holmes River is an affluent of the Choctawhatchee River. It is a deep stream, but was much obstructed by snags, logs, and overhanging trees.

During the fiscal year ending June 30, 1891, the sum of $3,000 was expended in removing these obstructions. For this purpose the log boat belonging to the Choctawhatchee River was used.

The river is now in good navigable condition, but there is very little trade carried on. The improvement made will probably render the navigation of the river safe for several years to come.

July 1, 1891, balance unexpended	$4,839.20
July 1, 1892, balance unexpended	4,839.20

(See Appendix P 5.)

6. *Choctawhatchee River, Florida and Alabama.*—When work on the improvement was begun in 1874, the river, although having an average width of 300 feet, was almost totally obstructed by the accumulation of logs and snags, and navigation was only possible by flatboats of light draft. The channel, if a channel existed at all, was exceedingly dangerous to navigation, particularly during the lower stages of water.

The project for improvement, adopted in 1880, provided for obtaining a low-water navigable channel from its mouth to Geneva, Ala., an estimated distance of 125 miles, and a navigable high-water channel from Geneva to Newton, Ala., an estimated distance of 37 miles.

In 1890 the project was amended to provide for securing a low-water channel from Geneva to Newton.

The improvement consists in the removal of logs and snags from the channel and overhanging trees from the banks, in deepening sand bars by works of contraction and shore protection, and in excavating a channel through the rock and marl shoals.

The expenditure, up to June 30, 1891, of $97,429.60, had resulted in sufficiently removing the obstructions from the river between its mouth and Caryville to meet the requirements of the present commerce on that section of the river, and in giving a fairly navigable channel, except at extreme low water, from the crossing of the Pensacola and Atlantic Railroad, at Caryville, Fla., to Geneva, Ala., a distance of 25 miles, and a partially improved channel from Geneva to Pate Landing, 25 miles above.

Steamboats now run with considerable regularity from Geneva, Ala., to the railroad at Caryville.

During the year ending June 30, 1892, $6,748.68 was expended in snagging operations between Geneva and Caryville, and in providing motive power for the snag boat.

Geneva is a thriving town, the trading and shipping center for a rich agricultural region surrounding it. The river affords the only practicable means of transportation to this district. During recent years the work has, therefore, mainly been directed to improving this section of the river, and has resulted in clearing out a large number of the accumulated logs and snags. Low-water navigation is impeded by several sand bars, which can be readily deepened by works of contraction and shore protection if sufficient funds are appropriated for the purpose.

When freight offers steamboats occasionally run to Pate Landing at favorable stages of water.

Since the completion of the Alabama Midland Railroad, from Montgomery, Ala., to Bainbridge, Ga., which passes through Newton, the urgent necessity for improving the upper portion of the river no longer exists, and it is doubtful if this section of the river would now be much used, even if the improvements were completed.

The plan, therefore, contemplates completing the improvement between Geneva and Caryville, and then between Geneva and Pate Landing, before beginning any work upon the marl shoals which now obstruct navigation between Newton and Pate Landing.

With larger appropriations, the improvement could be completed between Caryville and Pate Landing in a few working seasons, and thereafter only an annual expenditure of about $6,000 would be required for maintaining a snag boat for the removal of the logs and snags brought in by the winter freshets, and for the repair of works of contraction, unless it should be then decided to continue the improvement to Newton.

July 1, 1891, balance unexpended	$12,070.40
June 30, 1892, amount expended during fiscal year	6,748.68
July 1, 1892, balance unexpended	5,321.72
July 1, 1892, outstanding liabilities	829.99
July 1, 1892, balance available	4,491.73
Amount appropriated by act approved July 13, 1892	12,500.00
Amount available for fiscal year ending June 30, 1893	16,991.73

(See Appendix P 6.)

7. *Harbor at Pensacola, Florida.*—In 1878 the channel was much obstructed by wrecks, and a survey made in 1879 showed that the inner bar had shoaled to a depth of 19½ feet at mean low water. This depth was not sufficient to accommodate a large number of vessels seeking entrance to the port. The western shore of the entrance to the harbor, which is the site of old Fort McRee, was fast washing away, and a large portion of the fort had disappeared. Corresponding changes in the direction of the channel and of the tidal currents had occurred, and to this was partly attributed the shoaling of the inner bar. The removal of the wrecks was begun in 1878.

The plan of improvement adopted in 1881, in accordance with the report of the Board of Engineers, contemplated dredging a channel 300 feet wide and 24 feet deep at mean low water across the inner bar, for the temporary relief of the navigation of the harbor, and protecting the shore line near Fort McRee from further abrasion, with the view of preventing further injurious changes in the tidal currents, and retaining this position for defensive purposes.

The expenditure up to June 30, 1891, of $249,430.04 had resulted in obtaining, temporarily, a channel across the inner bar reported to be 120 feet wide and 24 feet deep, at mean low water, at the conclusion of dredging operations in 1886.

This channel had shoaled to a depth of 19 feet in June, 1891. The further abrasion of the western shore line near Fort McRee was stopped by the construction of two groins, north of the fort, and nearly at right angles to the shore, having lengths of 360 and 220 feet respectively. The groins were built of stone and concrete, and were completed in April, 1890.

During the year ending June 30, 1892, $11,380.52 was expended in the care and preservation of the property belonging to the improvement, in continuing the tests of cements used in the construction of the groins, and in dredging on the inner bar.

In June, 1891, the continued shoaling of the inner bar was causing such serious detriment to the commercial interests of the port—many loaded vessels being unable to leave the harbor—that the hiring of the suction dredge *Bayley*, from the Mississippi River Jetty Company, was authorized. The dredge began work on June 28, 1891, and continued pumping, when the weather permitted, until July 16, 1891, when the shaft was broken. The owners of the dredge then refused to go on with the work. It is estimated that 14,151 cubic yards of material was removed from the bar, giving an available increase of depth on the bar of about one foot and a half which has not, however, been preserved.

On January 17, 1891, a Board of Engineers was appointed to assemble at Pensacola, Fla., for the purpose of considering and reporting upon the improvement of the harbor. The report of the Board, dated July 16, 1891, is printed in the Annual Report of the Chief of Engineers for 1891, page 1723.

July 1, 1891, balance unexpended	$25,569.96
June 30, 1892, amount expended during fiscal year	11,380.52
July 1, 1892, balance unexpended	14,189.44
July 1, 1892, outstanding liabilities	325.50
July 1, 1892, balance available	13,863.94
Amount appropriated by act approved July 13, 1892	75,000.00
Amount available for fiscal year ending June 30, 1893	88,863.94

(See Appendix P 7.)

8. ***Escambia and Conecuh rivers, Florida and Alabama.***—These rivers are actually one river; that portion of the river from its headwaters in south Alabama to the Florida and Alabama State line being called the Conecuh River, and the portion in Florida, 61 miles long, being called the Escambia River. It empties into the Escambia Bay, which is itself an indentation from Pensacola Bay. Fully 50 per cent of the immense quantity of timber shipped from Pensacola Harbor is cut on lands tributary to this river and floated down in rafts to Pensacola Harbor.

The river originally was much obstructed by snags, sunken logs, and rock shoals, and by a very shoal bar at the mouth. Steamboat navigation was not attempted, and rafts had great difficulty in passing down the river.

The plan of improvement for this river, adopted pursuant to examinations and surveys made in 1878, contemplates the removal of snags, sunken logs, and other obstructions from the channel; cutting through rock shoals; and deepening sand bars, by works of contraction and shore protection, from the mouth of the river, in Pensacola Bay, to the mouth of Indian Creek, an estimated distance of 293 miles, for the purpose of facilitating the movement of timber down the river, affording at the same time facilities for steamboat navigation.

The amount expended up to June 30, 1891, $59,592.75, had resulted in providing, maintaining, and renewing the necessary plant; in twice dredging the channel through the bar at the mouth of the river to permit the passage of tugboats drawing not over 5 feet of water; in the removal of a large number of the accumulated logs and snags from its mouth to Thompson Cut-off, a distance of 133 miles; and in keeping the improved channel fairly free from logs and snags brought in by the winter freshets.

During the fiscal year ending June 30, 1892, $4,403.88 was expended in snagging operations. There was then a fairly navigable channel from the mouth of the river to Jordan Shoals, a distance of 136 miles, for stages of water 2½ feet above low water.

This river and its tributaries pass through the extensive timber lands of south Alabama and Florida, and the value of the lumber annually taken to market by the river is estimated at over $1,500,000.

In order that the business may be carried on safely and profitably the river should be kept free from snags and like obstructions by an efficient snag boat; and a channel 75 feet wide and 8½ feet deep should be dredged through the bar at the mouth of river, in order that the large tugs employed in towing the rafts to Pensacola may cross the bar and enter the river for the purpose of reaching the rafts. The rafts are now floated across the bar and fastened to timber stands in the open bay, where they are exposed to sudden storms, and considerable loss both in money and lumber is thus occasioned.

The cost of dredging the bar at the mouth of the river is estimated at $12,000. The annual cost of operating the snag boat is estimated at $6,000, or $12,000 for two years.

July 1, 1891, balance unexpended	$7,052.55
Amount received from settlement by Third Auditor of error in account of Capt. R. L. Hoxie, Corps of Engineers	22.41
	7,074.96
June 30, 1892, amount expended during fiscal year	4,403.88
July 1, 1892, balance unexpended	2,671.08
July 1, 1892, outstanding liabilities	521.08
July 1, 1892, balance available	2,150.00
Amount appropriated by act approved July 13, 1892	8,000.00
Amount available for fiscal year ending June 30, 1893	10,150.00

(See Appendix P 8.)

9. *Alabama River, Alabama.*—Before improvements were begun in 1878, the river was so full of sunken logs and snags, and so obstructed by bars, shoals, and reefs, on many of which the low-water depth was only 2½ to 3½ feet, that navigation was both difficult and dangerous, and many boats were destroyed. At low-water stages boats could only run by daylight, and long detentions at the bars and shoals were frequent. The normal width of the upper river is from 500 to 600 feet, and of the lower river from 700 to 800 feet. In the portions of the river having these widths the low-water depths vary from 8 to 15 feet; but where the river has been widened by the erosion of its banks, bars, shoals, and reefs are found. That portion below the Cut-off, 20 miles in length, was absolutely inaccessible during low water, and all landings situated thereupon have been deprived of steamboat service.

The plan of improvement adopted, pursuant to an examination and partial survey of this river, made under act of Congress approved March 3, 1875, provided for obtaining a channel 200 feet in width and 4 feet in depth, at low water, from the mouth of the river, 44 miles above Mobile, to Wetumpka, Ala., a distance of 323 miles, by the removal of snags, logs, etc., from the channel; cutting overhanging trees from the banks; removing rock and gravel reefs by blasting and dredging; and deepening sand bars by works of contraction and shore protection.

The expenditure of $167,444.22 up to June 30, 1891, had resulted in clearing the river of dangerous snags and logs and overhanging trees; in maintaining an efficient stern-wheel snag boat, for the removal of the logs and snags brought in by the winter freshets; in the improvement of eight of the worst bars, by works of contraction, which, however, are now in bad condition and need extensive repairs; in opening the 20 miles of river below the Cut-off; in increased safety to navigation; greater regularity and reduction in time of trips; and in enabling boats to carry larger loads. Boats now run by night as well as by day, at all stages of water.

During the fiscal year ending June 30, 1892, $10,541.56 was expended in snagging operations, and in slight repairs to the contraction works.

With the appropriation of $70,000, made by the river and harbor act approved July 13, 1892, it is proposed to provide an efficient working plant for the permanent improvement of the numerous bars which now give trouble at low-water stages.

The contraction works built between 1878 and 1883 gave so satisfactory results that no special difficulty is anticipated in securing low-water depths of from 4 to 6 feet, on all the bars now having less depths, provided sufficiently large appropriations are made to carry on the work with an efficient plant and a large working force during the low-water season.

It will be economy to make appropriations large enough to complete the improvement in a few seasons.

July 1, 1891, balance unexpended	$17,555.78
June 30, 1892, amount expended during fiscal year	10,541.56
July 1, 1892, balance unexpended	7,014.22
July 1, 1892, outstanding liabilities	2,270.76
July 1, 1892, balance available	4,743.46
Amount appropriated by act approved July 13, 1892	70,000.00
Amount available for fiscal year ending June 30, 1893	74,743.46

(See Appendix P 9.)

10. *Tallapoosa River, Alabama.*—When first examined, in 1881, low-water navigation was entirely impracticable, and high-water navigation was difficult and dangerous on account of the great accumulation of logs and snags in the channel, and of the numerous sand and gravel bars, and a few rock reefs. Where not obstructed, the river presented, generally, long reaches of fine navigable water, with a width of 200 to 300 feet, and a depth of 6 to 12 feet, but where the normal width was exceeded, to any extent, sand bars and gravel or rock reefs were found, with a low-water depth of only 1 to 2 feet.

The project for the improvement of the river, adopted in 1881, provides for obtaining a navigable channel from the junction with the Coosa River, where the two rivers form the Alabama River, to the foot of Tallassee Reefs, 2 miles below the town of Tallassee, a distance of 48 miles, with a least depth of 3 feet, and width of 200 feet in open river, and 60 feet through rock reefs, by the removal of snags and logs from the channel, and overhanging trees from the banks, by cutting through the rock and gravel reefs, and by deepening sand bars by works of contraction and shore protection.

The expenditure of $40,499.28 up to June 30, 1891, had resulted in building, equipping, and keeping in repair a snagboat (without motive power); in building 320 feet of temporary jetty; in removing, to a great extent, the original accumulation of snags and logs from the channel, and in cutting down dangerous overhanging timber between the mouth and Cole Ferry, an estimated distance of 43 miles. At the close of the working season, in November, 1889, that portion of the river was navigable for light-draft steamers, but, so far as known, no commercial use was made of it.

During the year ending June 30, 1892, $2,623.69 has been expended in the care and preservation of plant, and in snagging operations.

July 1, 1891, balance unexpended	$3,518.72
Amount received from error in settlement of account of Capt. R. L. Hoxie, Corps of Engineers	52.15
	3,570.87
June 30, 1892, amount expended during fiscal year	2,623.69
July 1, 1892, balance unexpended	947.18
July 1, 1892, outstanding liabilities	61.43
July 1, 1892, balance available	885.75

(See Appendix P 10.)

11. Coosa River, Georgia and Alabama.—With headwaters in the mountains of Northwestern Georgia, the Coosawattee, Oostenaula, Coosa, Alabama, and Mobile rivers form, in fact, one great river; which, when the improvement of the Coosa River is completed, will furnish a continuous route of water transportation, 776 miles in length, through the mineral fields of north Alabama, the agricultural belt of middle Alabama, and the timber region of south Alabama, to tidewater at Mobile Bay.

A distance of 293 miles of this water way, above Lock No. 4 (3 miles above the Georgia Pacific Railroad Bridge), and a distance of 367 miles between Wetumpka and Mobile, is now navigable.

Between Lock No. 4 and Wetumpka, a distance of 116 miles, the Coosa River has a low waterfall of 323 feet, and is obstructed by a series of rock shoals and reefs, separated by stretches of good navigable water, varying in length from one-half to 8 miles. The low-water discharge of the Coosa River at Wetumpka is 5,800 cubic feet, about the same as that reported for the Mississippi River at St. Paul.

The abundance of water, the stability of the banks and bottom of the river, and the rock foundations for locks and dams, presented in nearly all cases, make the lower portion of the river peculiarly susceptible to permanent improvement by a system of slackwater navigation.

Pursuant to the various examinations and surveys made between 1870 and 1889, a plan of improvement has been adopted, which contemplates the removal of the lesser rock shoals, and sand and gravel bars, by excavation, and by works of contraction; and the construction of locks and dams to overcome the more serious obstructions.

By the various acts making appropriations for its improvement, the Coosa River has been divided into two sections by the East Tennessee, Virginia and Georgia Railroad Bridge.

In the upper section, between Rome and the bridge (236 miles long), eight locks, with their accessory dams or dikes, will be required, of which three have been completed and opened to navigation, and the fourth is now under construction.

In the lower section, between Wetumpka and the bridge (68 miles long), twenty-three locks, with their accessory dams or dikes, will be required, of which Lock No. 31, at Wetumpka, is now under construction. The first appropriation for this section of the river was made by the act of September 19, 1890.

a. Between Rome, Georgia, and the East Tennessee, Virginia and

Georgia Railroad Bridge.—Before improvement the river was much obstructed by rock shoals and sand and gravel bars between Rome, Ga., and Greensport, Ala., a distance of 162 miles; and below Greensport it was not navigable at all, on account of the many shoals and rapids formed by ledges of rock crossing the river bottom at points where the width of the river was greater than the normal.

The expenditure up to June 30, 1891, of $583,384.92 had resulted in securing a fairly navigable channel from Rome to Greensport by blasting out the rock shoals and by the construction of wing dams to scour out the sand bars.

Below Greensport, at distances respectively of 0.68, 3.86, and 5.24 miles, three masonry locks, each having an available width of 40 feet and length of 175 feet, with their accessory dams or dikes, had been completed and opened to navigation. In consequence of the improvement steamboats made regular trips between Rome and Gadsden and, when business demands it, extend their trips to a landing 1 mile below Lock No. 3.

During the year ending June 30, 1892, the sum of $84,459.31 has been expended.

Cribs have been placed to mark the channel at the Greensport Reef, and guide cribs added above and below Lock No. 3 to aid boats entering and leaving the lock.

A stone dam parallel to the channel at the foot of Wood Island, a short distance below Lock No. 3, has been built to prevent the bad cross current which previously made this point dangerous for boats.

At the East and West Railroad Bridge, half a mile below Lock No. 3, the channel under the bridge has been improved by the railroad company by the removal of the cofferdams of the piers.

At Lonnergan Reef, about 2 miles below Lock No. 3, the channel has been straightened and improved and marked by timber cribs.

Dam No. 4, about 3 miles above Riverside, Ala., on the Georgia Pacific Railroad, has been nearly completed, and, with the work at Lonnergan Reef, makes navigation practicable on a moderate rise in the river as far as the dam. Dam No. 4 is 21 miles below Lock No. 3.

In order to complete this work economically, sufficiently large appropriations should be made to enable it to be carried on without interruption, with efficient plant and a large working force.

July 1, 1891, balance unexpended	$90, 315. 08
June 30, 1892, amount expended during fiscal year	84, 459. 31
July 1, 1892, balance unexpended	5, 855. 77
July 1, 1892, outstanding liabilities	3, 480. 52
July 1, 1892, balance available	2, 375. 25
Amount appropriated by act approved July 13, 1892	130, 000. 00
Amount available for fiscal year ending June 30, 1893	132, 375. 25
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	960, 133. 00

b. Between Wetumpka, Alabama, and the East Tennessee, Virginia and Georgia Railroad Bridge.—The first appropriation for the improvement of this section of the river was made by the act of September 19, 1890.

During the fiscal year ending June 30, 1891, $8,681.34 was expended in procuring the necessary outfit and in making detailed surveys for the precise location of the locks near Wetumpka and in making a series of velocity and discharge observations, extending from high to low water.

During the year ending June 30, 1892, the sum of $36,582.60 has been expended.

The detailed surveys begun in the previous fiscal year were completed and the precise location of Lock and Dam No. 31 was decided upon. The necessary land in the vicinity of Lock No. 31 was rented, pending the preliminaries to the purchase thereof. The land was filled up and graded, and the workshops, stables, etc., needed in the construction of the lock were built. Two thousand seven hundred and eighty-six cubic yards of rock was excavated from the reef above the Wetumpka Bridge, the greater part of which was used in making a temporary breakwater to divert the current from the lock site. Two barges for the transportation of sand were built. A large amount of machinery and plant was procured and put in place. A towboat was purchased. It is proposed to build the lock of Portland cement concrete, faced with granite. A contract for the delivery of 900 cubic yards of granite, cut to dimensions, has been made and the delivery begun. The construction of the cofferdam will be begun in July.

The cost of this work will be very materially increased unless the appropriations made are sufficiently large to enable it to be carried on without interruption, with efficient plant and with a large working force.

July 1, 1891, balance unexpended		$141,318.66
June 30, 1892, amount expended during fiscal year		36,582.60
July 1, 1892, balance unexpended		104,736.06
July 1, 1892, outstanding liabilities	$9,785.47	
July 1, 1892, amount covered by uncompleted contracts	17,339.10	
		27,124.57
July 1, 1892, balance available		77,611.49
Amount appropriated by act approved July 13, 1892		100,000.00
Amount available for fiscal year ending June 30, 1893		177,611.49
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		4,843,074.00

(See Appendix P 11.)

12. Operating and care of canals and other works of navigation on Coosa River, Georgia and Alabama.—The expenses of operating and care of Locks Nos. 1, 2, and 3 during the past fiscal year have been paid in the manner indicated by section 4, act of July 5, 1884.

The amount expended during the fiscal year ending June 30, 1892, was $6,614.28.

(See Appendix P 12.)

13. Cahaba River, Alabama.—The report of the examination of this river from its mouth to Centreville, Ala., in 1874, states that—

> On thirteen of the shoals there is only 1 foot of water and on two as little as eight-tenths of a foot. Besides this there are innumerable snags, the accumulation of years, and also a great quantity of leaning trees, which must be removed owing to the narrowness of the stream even at a stage several feet above low water. * * * The river is spanned by three bridges. * * * The railroad bridges are only a few inches above high water, while the road bridge is sometimes submerged.

The road bridge mentioned was carried away by the flood of 1881.

Under acts of Congress approved June 23, 1874, and June 17, 1880, examinations and partial surveys were made in 1874 and in 1880, and a plan of improvement was adopted which provides for obtaining for the lower Cahaba River, from its mouth to the town of Centreville, a distance of 88 miles, a navigable channel with a width in open river of 100 feet, and in soft-rock and bar cuts of 60 feet, having a depth at low water of 3 feet, by the removal of snags, etc., from the channel and overhanging trees from the banks, by cutting through the soft rock and gravel bars, and by contracting and regulating the channel.

The expenditure up to June 30, 1886, of $28,989.79 had resulted in the partial improvement of the river from its mouth to Centreville, adapting it to high-water navigation; but, on account of the obstructing railroad bridges, steamboats were unable to make any use of the improved river. Since that time no work has been done, because of a proviso in the river and harbor act of August 5, 1886, that—

> No part of said sum [$7,500 appropriated for this work] shall be expended until the officer in charge shall have reported that the railroad and other bridges across said river have been provided with good and sufficient draw openings.

These bridges continue to obstruct the navigation of the river, not having been provided with draw openings.

The act of September 19, 1890, provided that:

> The existing provision restricting the expenditure of the balance now available for the improvement of said river is hereby repealed, and said balance shall be expended in continuing the improvement thereof.

Under this act $3,506.56 was expended up to June 30, 1891, in the examination of the river in November, 1890, and in the partial construction and equipment of a light-draft log boat (to be used in the work on the river), which was nearly finished at the close of the fiscal year.

During the fiscal year ending June 30, 1892, $4,184.02 was expended in finishing the log boat, and in snagging operations.

The river was found to be so badly obstructed that with appropriations only sufficient for maintaining one working party, several seasons will be required to open the river for any useful navigation.

It is reported that previous to the building of the Alabama Central Railroad Bridge (21 miles above its mouth) several steamboats went up as high as Centreville, and brought out cargoes of cotton. In 1849, when the bridge was completed, navigation by steamboats ceased until 1880, when an attempt was made by a small steamer to navigate the river; she proceeded as high as Centreville, obtained a load of cotton, but on her passage down became disabled and capsized.

Under the provisions of the act of September 19, 1890, and by direction of the Secretary of War, notice dated April 11, 1892, was served on the proper officials of the East Tennessee, Virginia and Georgia Railroad, and Birmingham, Selma and New Orleans Railroad Company, respectively, to provide their bridges crossing the Cahaba River with suitable draw openings by January 1, 1893.

July 1, 1891, balance unexpended	$4,263.79
June 30, 1892, amount expended during fiscal year	4,184.02
July 1, 1892, balance unexpended	79.77
July 1, 1892, outstanding liabilities	8.70
July 1, 1892, balance available	71.07
Amount appropriated by act approved July 13, 1892	7,500.00
Amount available for fiscal year ending June 30, 1893	7,571.07

(See Appendix P 13.)

IMPROVEMENT OF CERTAIN RIVERS IN ALABAMA AND MISSISSIPPI, OF BOGUE CHITTO, LOUISIANA, AND OF HARBORS AT MOBILE, ALABAMA, AND BILOXI, MISSISSIPPI.

Officer in charge, Maj. A. N. Damrell, Corps of Engineers, with Lieut. Eben E. Winslow, Corps of Engineers, under his immediate orders since May 23, 1892; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Mobile Harbor, Alabama.*—The channel had originally a minimum depth of 5½ feet through Choctaw Pass and 8 feet on Dog River Bar.

This was deepened by dredging under appropriations from 1826 to 1852 of $228,830.68 to 10 feet through both. In 1860 the channel in Choctaw Pass had shoaled to 7½ feet. From 1870 to 1878 the channel was deepened by dredging to 13 feet, under appropriations amounting to $401,000. Length of cut 8 miles.

From 1881 to 1888 the channel was deepened by dredging to 17 feet, under appropriations amounting to $740,000, but this project was not completed when the last project was adopted. The length of cut was 25.91 miles.

The present project for the improvement of this harbor was adopted in August, 1888, the object being to afford a channel of entrance from the Gulf of Mexico to the city of Mobile of 280 feet width on top of cut with a central depth of 23 feet at mean low water by dredging, at an estimated cost of $1,980,000. Act of September 19, 1890, extended the work up Mobile River to the mouth of Chickasabogue Creek and increased the estimated cost to $2,043,800.

The entire length of channel under present project is 31.85 miles and the entire length of continuous cut is 29.98 miles.

The amount expended on the present project up to the close of the fiscal year ending June 30, 1891, was $306,680.32.

The average central depth of the dredged channel on June 30, 1891, was 19.4 and the minimum depth on that date was 14.7 feet.

The amount expended during the fiscal year ending June 30, 1892, was $275,198.23 and on that date the average central depth of the entire channel was 24 feet and the minimum central depth was 20.2 with no increase of width.

July 1, 1891, balance unexpended		$293,319.68
June 30, 1892, amount expended during fiscal year		275,198.23
July 1, 1892, balance unexpended		18,121.45
July 1, 1892, outstanding liabilities	$11,871.34	
July 1, 1892, amount covered by uncompleted contracts	4,478.80	
		16,350.14
July 1, 1892, balance available		1,771.31
Amount appropriated by act approved July 13, 1892		212,500.00
Amount available for fiscal year ending June 30, 1893		214,271.31

Amount (estimated) required for completion of existing project	1,181,300.00
Amount (estimated) required for preservation of improvement	120,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	1,000,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix Q 1.)

2. *Black Warrior River, Alabama, from Tuscaloosa to Daniels Creek.*—The present channel is only navigable during very high water, and is even then extremely dangerous.

The present project for the improvement of this section of the river was adopted in 1886, the object being to afford a water-way for the transportation of coal, iron ore, iron, etc., in barges, from the Warrior coal fields to the Gulf of Mexico, by the construction of five locks and dams, at an estimated cost of $741,670.

The amount expended to June 30, 1891, was $247,671.49, resulting as follows:

Lock No. 1. Locktender's house built and used at present as an engineer's office. Masonry completed except laying the bank-wall coping, which is in readiness. Area back of bank wall paved, and bank sloped and turfed. A flight of fifty steps down to the lock constructed. Base of dam leveled up to elevation (106); 1,300 yards of stone for dam on hand.

Lock No. 2. Cofferdam (550 feet long) built, and pump and boiler placed in position for pumping. Incline into lock chamber graded, 1,500 feet long. Cut-stone on hand, 994 yards. Rough ashlar on hand, 130 yards. Backing on hand, 2,600 yards. Sand for mortar delivered, 850 yards.

Lock No. 3. Cofferdam 1,330 feet long completed, inclosing also 7 acres of river bed for quarry. Incline to lock and quarry graded, 1,500 feet long.

The amount expended during the fiscal year ending June 30, 1892, is $76,783.43, and the present condition of the work is as follows:

Lock No. 1. Locktender's house built and occupied as an engineer office. Lock masonry completed. Base of dam filled in to within 9 feet on the crest. Lock yard paved, and bank sloped and turfed, and steps laid. The stones are on hand prepared for the abutment and dam.

Lock No. 2. The river wall is completed, 1,341 yards of masonry have been laid in the bank wall, and the stone for finishing it is in readiness.

Lock No. 3. Cofferdam built and 356 yards of ashlar quarried. The foundation for the lock walls is being excavated.

July 1, 1891, balance unexpended	$108,578.51
June 30, 1892, amount expended during fiscal year	76,783.43
July 1, 1892, balance unexpended	31,795.08
July 1, 1892, outstanding liabilities	6,197.47
July 1, 1892, balance available	25,597.61
Amount appropriated by act approved July 13, 1892	200,000.00
Amount available for fiscal year ending June 30, 1893	225,597.61
Amount (estimated) required for completion of existing project	185,420.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix Q 2.)

3. Warrior and Tombigbee rivers, Alabama and Mississippi.—a. Warrior River, Alabama.—The channel of this river was originally obstructed to such an extent by logs, snags, overhanging trees, and numerous bars, that navigation at low water was impossible and at high water extremely hazardous.

The present project for the improvement of this river was adopted in 1890, the object being to obtain a channel 6 feet deep at ordinary low water from Tuscaloosa to its mouth by removal of logs, snags and overhanging trees, the improvement of bars, bank revetment, and the construction of locks and dams at an estimated cost of $577,000.

The amount expended during the fiscal year ending June 30, 1891, was $21,840.85 and was used in construction of a portion of plant required for prosecution of the work, no improvement being effected.

The amount expended during the fiscal year ending June 30, 1892, was $26,831.01 in preparation of plant and the removal of snags, logs, and overhanging trees, no increased depth being obtained; but the time required to run the river and the hazard attending have both been reduced.

July 1, 1891, balance unexpended	$37,127.13
June 30, 1892, amount expended during fiscal year	26,831.01
July 1, 1892, balance unexpended	10,296.12
Amount appropriated by act approved July 13, 1892	75,000.00
Amount available for fiscal year ending June 30, 1893	85,296.12
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	457,000.00

b. Tombigbee River, Mississippi, from Walkers Bridge to Fulton.—The channel was originally only navigable for small rafts during high water, and very troublesome for them.

The present project for the improvement of this section of the river was adopted in 1888, the object being to obtain a good channel for navigation during high water by the removal of snags, logs, stumps, and cutting overhanging trees, at an estimated cost of $11,000.

The amount expended up to the close of the fiscal year ending June 30, 1891, was $6,517.18, and resulted in completion of the project.

July 1, 1891, balance unexpended	$1,482.82
June 30, 1892, amount expended during fiscal year	1,073.93
July 1, 1892, balance unexpended	408.89
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	3,408.89
Amount (estimated) required for preservation of improvement Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	1,000.00

c. Tombigbee River, from Fulton, Mississippi, to Vienna, Alabama.—The channel, before improvement, was not navigable at all from Fulton down to Cotton Gin Port, 69½ miles; from Cotton Gin Port down to Aberdeen, about 25 miles, it was navigable for small barges carrying about 125 bales of cotton; from Aberdeen down to Columbus, about 49½ miles, navigation was difficult when the river was 12 feet above ordinary low water; from Columbus down to Vienna the channel was much obstructed by snags and overhanging trees, and there was only 1 foot of water on some of the bars during low water. The project for the improvement of the river from Fulton down to Columbus, 144 miles, was adopted in 1873, the object being to give a good high-water navigation throughout by the removal of snags and overhanging trees. The project for the improvement of the portion of the river between Columbus and Vienna was adopted in 1879, the object being to afford a channel of navigable width and 3 feet deep during ordinary low water.

The amount expended to June 30, 1891, was about $87,335.79 (exact figures can not be given, for reasons that appropriations were made jointly for Warrior and Tombigbee rivers) and resulted in the completion of the proposed improvement of that section of the river from Fulton down to Columbus, and in giving such a channel from Columbus down to Vienna that navigation was possible, on a 2-foot rise, for boats drawing 3 feet, and the accomplishment of over one-half the work.

The amount of $4,714.26 has been expended during the fiscal year ending June 30, 1892, in the removal of snags, logs, and overhanging trees, in preservation of improvement previously obtained. This section of the river should be designated hereafter as Fulton to Columbus, the portion below Columbus being incorporated by the act of September 19, 1890, with that designated "Tombigbee River from Demopolis to Columbus, Miss."

July 1, 1891, balance unexpended	$4,714.26
June 30, 1892, amount expended during fiscal year	4,714.26
Amount appropriated by act approved July 13, 1892	6,000.00
Amount (estimated) required for preservation of improvement	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

d. Tombigbee River, Alabama, up to Demopolis.—At the present time the channel has a minimum depth of 2 feet.

The present project for the improvement of this section of the river was adopted in 1890, the object being to secure a channel of 6 feet depth at low water, by removal of logs, snags, and bank revetment, and construction of locks and dams, at an estimated cost of $508,898. The entire length of this section is 191 miles. The amount expended during the fiscal year ending June 30, 1891, was $9,648.98, and resulted in removal of logs, snags, and overhanging trees from 65 miles of the lower and best part of the river, and the partial improvement of 37½ miles more.

The amount expended during the fiscal year ending June 30, 1892, was $38,538.87, and resulted in removal of logs, snags, trees, etc., from Milers Gin to Barneys Shoals, in repair of jetties at Osage and Barneys Shoals, removal of snags, logs, trees, etc., from Demopolis, Ala., 12 miles downstream, and the partial improvement of McGrews, Pearsons, and Woods Bluff Shoals.

July 1, 1891, balance unexpended	$45,351.02
June 30, 1892, amount expended during fiscal year	38,538.87
July 1, 1892, balance unexpended	6,812.15
Amount appropriated by act approved July 13, 1892	125,000.00
Amount available for fiscal year ending June 30, 1893	131,812.15
Amount (estimated) required for completion of existing project	328,808.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

e. Tombigbee River from Demopolis, Alabama, to Columbus, Mississippi.—The present channel has a minimum depth of 1 foot.

The present project for the improvement of this section of the river was adopted in 1890, the object being to obtain a channel of 6 feet depth at an ordinary low water by removal of logs, snags, etc., bank revetment, and construction of locks and dams, at an estimated cost of $779,400.

The amount expended up to the close of the fiscal year ending June 30, 1891, was $288 in the preparation of a portion of the plant and the commencement of the work proper.

The amount expended during the fiscal year ending June 30, 1892, is $14,712, and resulted in clearing 22½ miles from Windham down, in the lower part of this section of the river, of snags, logs, and overhanging trees, and in a similar improvement of the greater part of Ten-Mile Shoals, extending from about 10 to 20 miles below Columbus.

July 1, 1891, balance unexpended	$14,712.00
June 30, 1892, amount expended during fiscal year	14,712.00
Amount appropriated by act approved July 13, 1892	35,000.00
Amount (estimated) required for completion of existing project	729,400.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q 3.)

4. *Noxubee River, Mississippi.*—The original condition of the river was such that during all seasons of the year and at all stages of water navigation, except by small flatboats, was practically impossible.

The present project for the improvement of this river was adopted in 1880, the object being to afford a channel for small river steamers from its mouth up to Macon, Miss., of navigable width and depth when the water is above ordinary low-water stage.

The amount expended up to the close of the fiscal year ending June 30, 1891, was $49,742.54, and resulted in completion of the project.

The amount expended during the fiscal year ending June 30, 1892, was for care and preservation of public property.

July 1, 1891, balance unexpended	$3,257.46
June 30, 1892, amount expended during fiscal year	156.75
July 1, 1892, balance unexpended	3,100.71
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	6,100.71
Amount (estimated) required for preservation of improvement	6,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q 4.)

5. *Pascagoula River, Mississippi.*—The channel over the bar before the improvement commenced had a least depth of 3 feet. This was increased to 7½ feet, with a width of 180 feet, by dredging, from 1878 to 1880, at a cost of about $42,500. From the light-house near the mouth of the river to its head there was a navigable channel obtained by the removal of snags and overhanging trees, from 1881 to 1884, inclusive, at a cost of about $15,000.

The present project for the improvement of this river was adopted in 1886, the object being to afford a channel of navigable width and minimum depth of 12 feet at mean low water from Moss Point down to the anchorage in the sound, and to maintain the river above Moss Point in its improved condition, at an estimated cost of $78,100 for the channel from Moss Point down, and $2,500 annually for preservation of improvement above Moss Point.

The amount expended to June 30, 1891, was $56,166.97 and resulted in the completion of more than one-half of the work needed to complete the project from Moss Point to the mouth of the river.

The amount expended during the fiscal year ending June 30, 1892, was $14,099.87 and resulted in the completion of more than one-third of the work needed to complete the project from the mouth of the river over the bar. The officer in charge reports that it has been necessary to increase the estimate for completion of this work, owing to the hardness of a portion of the material to be dredged.

The amount available is to be expended in the further improvement of the channel according to the project and in the removal of such obstructions in the river above Moss Point as have lodged during the suspension of work.

July 1, 1891, balance unexpended	$15,833.03
June 30, 1892, amount expended during fiscal year	14,099.87
July 1, 1892, balance unexpended	1,733.16
Amount appropriated by act approved July 13, 1892	20,000.00
Amount available for fiscal year ending June 30, 1893	21,733.16
Amount (estimated) required for completion of existing project	49,000.00
Amount (estimated) required for preservation of improvement above Moss Point	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q 5.)

6. *Chickasahay River, Mississippi.*—At the time of the adoption of the present project the channel was only navigable for small rafts during high water and was difficult and troublesome for them. The minimum width of the channel is 50 feet and the minimum depth 0.5 foot at extreme low water. The project for the improvement of this river was adopted in 1890, the object being to obtain a good high-water channel from the mouth up to the railroad bridge near Shubuta by the removal of snags, logs, and overhanging trees, at an estimated cost of $30,000.

The amount expended during the fiscal year ending June 30, 1892, was $4,595.27, and resulted in giving a high-water channel that allows much larger rafts than formerly to be brought downstream with comparative ease.

July 1, 1891, balance unexpended	$5,000.00
June 30, 1892, amount expended during fiscal year	4,595.27
July 1, 1892, balance unexpended	404.73
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,404.73
Amount (estimated) required for completion of existing project	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q 6.)

7. *Bluff Creek, Mississippi.*—At the time of the adoption of the present project navigation was obstructed by leaning trees and logs.

The minimum width of the river is 100 feet and the minimum depth 10 feet.

The project for the improvement of this creek was adopted in 1890, the object being to obtain a channel from the mouth up to Vancleaves by the removal of snags, logs, and overhanging trees, at an estimated cost of $1,000.

The amount expended during the fiscal year ending June 30, 1892, was $999.51 and resulted in the completion of the project.

July 1, 1891, balance unexpended	$1,000.00
June 30, 1892, amount expended during fiscal year	999.51
July 1, 1892, balance unexpended	.49

(See Appendix Q 7.)

8. *Leaf River, Mississippi.*—At the time of the adoption of the present project the river was not navigable on account of snags, logs, and overhanging trees.

The minimum width of the river channel is 100 feet and the minimum depth 2.5 feet.

The project for the improvement of this river was adopted in 1890, the object being to obtain a high-water channel from the mouth to the mouth of Bowie Creek by the removal of logs, snags, and overhanging trees, at an estimated cost of $25,000.

The amount expended during the fiscal year ending June 30, 1892, was $4,597.86 and resulted in giving a high-water channel from Hattiesburg to Augusta, Miss., a distance of 40 miles.

July 1, 1891, balance unexpended	$5,000.00
June 30, 1892, amount expended during fiscal year	4,597.86
July 1, 1892, balance unexpended	402.14
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,402.14
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	15,000.00

(See Appendix Q 8.)

9. Harbor at Biloxi, Mississippi.—The original condition of the channel was such as to allow only vessels of 5-foot draft to enter the harbor.

The present project for the improvement of this harbor was adopted in 1882, the object being to afford a channel of entrance from Mississippi Sound to the wharves of Biloxi of navigable width and 8 feet deep, at an estimated cost of $55,000.

The amount expended to June 30, 1891, was $34,148.64 and resulted in dredging a channel 9 feet deep at mean low water and 120 feet wide throughout.

The present project is therefore completed.

About $8,000 every 4 or 5 years will be ample for preservation of the improvement.

July 1, 1891, balance unexpended	$10,851.36
July 1, 1892, balance unexpended	10,851.36

(See Appendix Q 9.)

10. Pearl River, Mississippi, below Jackson.—The original condition of the navigable channel of this portion of the river was such as allow navigation only during high water, and then it was difficult and dangerous. The minimum width of the stream was 190 feet, except through Holmes Bayou, which was only 65 feet wide. The minimum width of the channel was 65 feet. The minimum depth of the channel at low water was 1½ feet.

The original project for the improvement of this portion of the river was adopted in 1880, the object being to obtain a 5-foot channel at low water, at an estimated cost of $95,940.

A clear 5-foot channel at low water was found to be impracticable, but a 2-foot clear channel could be obtained. This amendment to the original project was approved in 1885 and the estimate was increased $50,000.

The amount expended on the work up to June 30, 1891, was $105,438.80. The condition of this part of the river on June 30, 1891, was such as to allow light-draft boats to navigate from the mouth, at the Rigolets, La., to Wheats Fields, Miss., 106 miles, all the year; from Wheats Fields to Columbia, Miss., 50 miles, on a 6-foot rise, and from Columbia, Miss., to Jackson, Miss, 159 miles, on a 7-foot rise.

The results obtained by the improvement of this section of the river during the fiscal year ending June 30, 1892, are an increased depth of 10 inches at low water from the mouth up to Latons Bluff, 126 miles, and an increased width of 95 feet through Holmes Bayou.

July 1, 1891, balance unexpended	$22,686.20
June 30, 1892, amount expended during fiscal year	10,823.43
July 1, 1892, balance unexpended	11,862.77
Amount appropriated by act approved July 13, 1892	15,000.00
Amount available for fiscal year ending June 30, 1893	26,862.77
Amount (estimated) required for completion of existing project	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q 10.)

11. Pearl River, Mississippi, between Carthage and Jackson.—The original condition of this part of the river was such as to make navigation almost impossible except in high water.

The minimum width of the river was 100 feet; the minimum depth, at low water, was 1 foot; the minimum width of the channel was 40 feet.

The original project adopted for the improvement of this river consisted in the removal of snags, logs, trees, etc., and was to afford a clear channel of navigable width, 5 feet deep at low water, from Jackson to Carthage, 105 miles, at an estimated cost of $21,000.

A clear 5-foot channel at low water was found to be impracticable by the method proposed, but a 2-foot clear channel at low water could be obtained and was all that the present commerce of the river required.

The original estimate was increased $29,000. (See Annual Report, 1886–'87, Q 2, page 1336.)

The amount expended on this work up to the close of the fiscal year ending June 30, 1891, was $24,779.10.

The condition of the improvement on June 30, 1891, is such as to allow light-draft boats to navigate with comparative safety, on a 3-foot rise above ordinary low water, from Carthage down, 102 miles, and the remaining distance down to Jackson, 3 miles, on a 4-foot rise.

The condition of the improvement on June 30, 1892, was such as to allow light-draft boats to navigate safely on a 3-foot stage above low water from Carthage to Jackson.

The results obtained by the improvement of this section of the river are an increased depth of 2 feet, on account of removal of snags, sunken logs and trees, and an increased width of at least 20 feet of the channel, on account of trimming off points.

There is also a large reduction and saving in freights and insurance rates.

The amount expended during the fiscal year ending June 30, 1892, is $1,288.28.

Project completed.

July 1, 1891, balance unexpended	$1,470.90
June 30, 1892, amount expended during fiscal year	1,288.28
July 1, 1892, balance unexpended	182.62
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,182.62

Amount (estimated) required for preservation of improvement	$2,400.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q 11.)

12. *Pearl River, Mississippi, between Edinburg and Carthage.*—The original condition of this portion of the river was such that navigation at low water was impossible, and even during very high water it was difficult and dangerous.

The minimum width of the channel was 20 feet. The minimum depth at low water was 8 inches.

The project for the improvement of this portion of the river, adopted in 1884, was to afford a high-water channel from Edinburg to Carthage, a distance of 24¾ miles, for 6 or 8 months of the year, at an estimated cost of $13,464.

The amount expended on the work up to June 30, 1891, was $9,721.13.

The condition of this part of the river on June 30, 1891, was such as to allow light-draft boats to navigate with comparative safety from Edinburg to Carthage, on a 4½-foot rise above ordinary low water.

The results obtained by the improvement of this portion of the river, during the fiscal year ending June 30, 1892, are an increased width of 15 feet and an increased depth of 2 feet at low water.

Project completed.

July 1, 1891, balance unexpended	$5,028.87
June 30, 1892, amount expended during fiscal year	2,654.57
July 1, 1892, balance unexpended	2,374.30
Amount appropriated by act approved July 13, 1892	500.00
Amount available for fiscal year ending June 30, 1893	2,874.30
Amount (estimated) required for preservation of improvement	500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q 12.)

13. *Bogue Chitto, Louisiana.*—The channel at present is not navigable at ordinary low water, it being obstructed by snags, logs, fish-traps, etc.

The minimum width of the stream is 120 feet and that of the channel 80 feet; the minimum depth, 3 feet.

The project of the improvement of this river was adopted in 1890, the object being to obtain a 3-foot channel during the greater part of the year by the removal of logs, snags, fish traps, etc., from the mouth up to Alford's bridge, at an estimated cost of $30,000.

The amount expended during the fiscal year ending June 30, 1892, $1,000, was applied to preparation of plant for the work. There is no change in the condition of the river, the work of improvement not having been begun.

July 1, 1891, balance unexpended	$5,000.00
June 30, 1892, amount expended during fiscal year	1,000.00
July 1, 1892, balance unexpended	4,000.00
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	9,000.00
Amount (estimated) required for completion of existing project	20,000.00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q 13.)

INSPECTION OF THE IMPROVEMENT OF THE SOUTH PASS OF THE MISSISSIPPI RIVER.

Inspecting officer, Maj. James B. Quinn, Corps of Engineers.

The inspecting officer in his annual report hereto appended, reports but little construction work having been done at the Head of the Passes and in South Pass during the year.

At the mouth of South Pass eight new wing dams were built, and twenty of the older ones repaired.

A legal channel was maintained during the year at the head of South Pass, and "through the pass itself," but during a period of 32 days, from May 20 to June 20, both dates inclusive, such channel did not obtain "through the jetties" at the mouth of South Pass. During this period, however, there was a navigable depth of 28.1 feet.

Over an area containing 1¼ square miles, lying immediately beyond the sea ends of the jetties, there was an average shoaling of 1.59 feet during the year.

July 1, 1891, balance unexpended	$10,000.00
June 30, 1892, amount expended during fiscal year	9,200.90
July 1, 1892, balance unexpended	799.10
Amount appropriated by act of August 11, 1888	10,000.00
Amount available for fiscal year ending June 30, 1893	10,799.10

(See Appendix R.)

IMPROVEMENT OF CERTAIN STREAMS IN LOUISIANA, AND OF HARBOR AT SABINE PASS, SABINE RIVER, AND NECHES RIVER, TEXAS.

Officer in charge, Maj. James B. Quinn, Corps of Engineers; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Chefuncte (Tchefuncte) River and Bogue Falia, Louisiana.*—Previous to improvement these streams were obstructed by snags, logs, and overhanging trees. The bar at the mouth of the river had a depth of water of about 4½ feet at the lowest stage.

The project for the improvement of the river was adopted in 1880, and contemplated the removal of obstructions in the channel and the dredging of the bar at its mouth, and was modified in 1884 so as to provide for the building of a breakwater across the bar.

With the first two appropriations of $1,500 each, made in 1881 and 1882, the obstructions were removed below Covington, and part of the unexpended balance was used for constructing 820 feet of the breakwater, but the bar at the mouth was not dredged, as it would be likely to re-form.

To prevent this or retard its reformation, the officer in charge in 1884 recommended building a breakwater extending 2,500 feet into the lake and then dredging a channel through the bar.

The original estimated cost of the improvement was $5,460, but this did not provide for building the breakwater.

Under the appropriation of $2,500 made in 1886, channels 5 feet in depth and 30 to 60 feet wide were cut through the bars on the Bogue Falia between Old Landing and Covington, giving better navigation for schooners to and from Covington.

The amount expended to June 30, 1891, was $5,500. At that date the river was navigable for steamers drawing 5 feet to Old Landing, about 12 miles above its mouth, and then for the lighter-draft schooners to Covington, about 2 miles farther up on the Bogue Falia. The river and bayou were somewhat obstructed with snag, logs, etc. The bar at the mouth of the river has a depth of about 5 feet at the lowest stage of the water.

In October, 1891, the work of removing the most dangerous obstructions in the channel was commenced, under the appropriation of $1,000 made September 19, 1890, with hired labor, using the Government snagging plant, which had shortly before finished work on the Tickfaw River.

The river was cleared of logs, snags, and impending trees from Madisonville to Old Landing, and from the latter place to Covington, on the Bogue Falia, as far as the funds available would permit, materially lessening the dangers of navigation. Operations were discontinued November 30, 1891, and the plant was laid up at Madisonville. The amount expended on this work during the fiscal year ending June 30, 1892, was $789.26.

July 1, 1891, balance unexpended	$1,000.00
June 30, 1892, amount expended during fiscal year	789.26
July 1, 1892, balance unexpended	210.74
Amount appropriated by act approved July 13, 1892	1,000.00
Amount available for fiscal year ending June 30, 1893	1,210.74

(See Appendix S 1.)

2. *Tickfaw River and its tributaries, Louisiana.*—When the project for improvement was adopted the Tickfaw River and its navigable branches were obstructed by snags, sunken logs, and trees.

Congress authorized an examination of this river in 1879. A project was submitted in 1881 to clean out the river and its principal tributaries, the Natalbany, Blood, and Ponchatoula rivers, by removing the obstructions, at an estimated cost of $10,230.

To June 30, 1891, the appropriations made by Congress in 1881, 1882, 1886, and 1888, aggregating $7,000, had been expended. Twenty miles of the Tickfaw, and the Natalbany to Springfield, the head of navigation, had been improved. Work was also done on the Ponchatoula as far as it was thought advisable, and the Blood River had been cleaned out as far as navigable.

Under the appropriation of $1,000 made September 19, 1890, work of removing the obstructions that had re-formed since 1889, was commenced September 14, 1891, with hired labor and the use of the Government snagging plant which had but recently finished work on the Amite River. Operations were discontinued in October of that year.

Snags, overhanging trees, and logs were removed from the Tickfaw, Natalbany, and Blood rivers, the latter being cleared to the head of navigation. The extent of channels improved on the three rivers was about 39 miles, and the sum of $777.96 was expended on this work during the year ending June 30, 1892.

The improvement is not permanent, as obstructions will continue to form in all these streams, but an annual appropriation of $1,000 will keep them in good order.

Although the improvement is not of a permanent or conspicuous character, the little which has been accomplished has resulted in a very material increase in the commerce of the river. Most of the shipments are made direct to New Orleans.

July 1, 1891, balance unexpended	$1,000.00
June 30, 1892, amount expended during fiscal year	777.96
July 1, 1892, balance unexpended	222.04
Amount appropriated by act approved July 13, 1892	1,000.00
Amount available for fiscal year ending June 30, 1893	1,222.04

(See Appendix S 2.)

3. *Amite River and Bayou Manchac, Louisiana.*—Before improvement was commenced the Amite River and Bayou Manchac, its principal tributary, were navigable by the ordinary river steamboat below and for a short distance above their point of junction, but the navigation was very much impeded and endangered by snags, stumps, impending trees, etc.

In 1880 a project was adopted for the improvement of the Amite River, providing for a low-water channel 5 feet in depth as far up stream as appropriations would permit, the main part of the work to be done above the mouth of the Bayou Manchac. An effort was made to do the work by contract, but the results were unsatisfactory, and in 1883 the original project was modified so as to permit the use of the Government plant and hired labor, the improvement to be made below the mouth of the Bayou Manchac.

Up to the close of the fiscal year ending June 30, 1891, there had been expended on these streams the sum of $22,677.86. At that date vessels drawing 5 feet of water could navigate the bayou from its mouth to Wards Creek, on the Bayou Manchac, and the river was navigable for vessels of like draft from the mouth to its junction with the Bayou Manchac, but navigation on both streams was somewhat hampered by obstructions which required removal.

The work of improvement was continued from July 1 to August 29, 1891, under the appropriation of September 19, 1890, with the Government plant and hired labor. Snags, logs, and impending trees were removed from the bayou between Hope Villa and its mouth and from the river between its mouth and the junction with Bayou Manchac. The extent of channel improved was about 13 miles, resulting in giving much relief to navigation.

The amount expended on this work during the year just closed was $950.29.

Owing to the caving of the banks of these streams the permanent improvement is hardly possible, and about $2,500 will be required annually to keep them free of obstructions.

July 1, 1891, balance unexpended	$1,122.14
June 30, 1892, amount expended during fiscal year	950.29
July 1, 1892, balance unexpended	171.85
Amount appropriated by act approved July 13, 1892	2,500.00
Amount available for fiscal year ending June 30, 1893	2,671.85

(See Appendix S 3.)

4. *Bayou Lafourche, Louisiana.*—Prior to 1879 the navigation of the Bayou Lafourche was very much obstructed by snags, logs, raft heaps, impending trees, and wrecks.

In 1879 a project was approved for the removal of these obstructions, and work under this project was carried on until 1885.

In 1888 Congress appropriated $50,000 for the improvement of the bayou, on the plan of Lieutenant Crosby, Corps of Engineers, dated June 11, 1886, and provided for dredging for the immediate relief of low-water navigation.

Lieutenant Crosby's project was for a lock at the head of the bayou, connecting it with the Mississippi River, and subsequent dredging of the bayou channel to a width of 75 feet, with a depth of 5 feet at mean low water of the Gulf. The estimated cost was $450,000, with an annual expenditure of $8,000 for operation and maintenance.

Under the provision of this act dredging was commenced at the head of the bayou, and has been continued since at intervals. The sum of $57,283.44 has been expended on the improvement of this stream to June 30, 1891, with considerable benefit to the low-water navigation.

As soon as the stage of water permitted the work of improving navigation was resumed August 5, 1891, and after dredging a channel for 3½ miles, and removing stumps and wrecks, flatboat navigation was rendered practicable during low water for a distance of 32 miles. Dredging was discontinued January 26, 1892, on account of high water.

The amount expended on this work during the year ending June 30, 1892, was $16,060.36.

Dredging is a very unsatisfactory method of improvement, as much of the work has to be gone over again after the subsidence of the flood in the Mississippi River. If the lock was constructed, whatever dredging was thereafter done would be practically permanent and the certainty and safety of the navigation of the bayou assured.

July 1, 1891, balance unexpended	$72,716.56
June 30, 1892, amount expended during fiscal year	16,060.36
July 1, 1892, balance unexpended	56,656.20
July 1, 1892, outstanding liabilities	175.00
July 1, 1892, balance available	56,481.20
Amount appropriated by act approved July 13, 1892	50,000.00
Amount available for fiscal year ending June 30, 1893	106,481.20
Amount (estimated) required for completion of existing project	350,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix S 4.)

5. *Bayou Terrebonne, Louisiana.*—When work was commenced, in 1880, Bayou Terrebonne was little better than a drainage ditch, being about 11 feet wide when dredging began.

The project called for the dredging of a channel 4 feet deep at mean low water of the Gulf to Houma. The cost of the improvement of this bayou was estimated at $38,800. The completion of the work to Houma as projected cost $35,808, enabling planters to ship their merchandise to Houma or else to New Orleans by connecting bayous and canals.

July 1, 1891, balance unexpended	$2,992
July 1, 1892, balance unexpended	2,992

(See Appendix S 5.)

6. *Bayou Plaquemine, Louisiana.*—The work of securing the mouth of this bayou from further caving is under the charge of Capt. John Millis, Corps of Engineers, whose annual report thereon is submitted as Appendix T 1. A summary of the work done under his direction is given below, page 223.

Previous to the closing of the mouth of Bayou Plaquemine by a dam, in 1867 or 1868, the largest steamboat passed through it into Grand Lake and the numerous water routes connected with it.

In 1885 a project was proposed for reëstablishing this water route by building a lock at the head of the bayou and dredging out the channel below. In 1888 $100,000 was appropriated for improving the bayou and protecting the bank at its mouth from caving; $75,000 of this sum was allotted to bank protection at the mouth: the remainder has been devoted to dredging out the bayou, so as to give a channel 60 feet wide and 6 feet deep at mean low water-level of the Gulf.

This dredging progressed until, at the end of June, 1891, it had nearly reached the railroad bridge. The cut was about 5 miles long and 30 feet wide, and $16,984.31 had been expended on this work at that time.

During the following fiscal year the dredging was continued until the bridge was reached, and since the draw in this bridge had not been completed the dredge turned back and widened the cut to 60 feet for a distance of about one-half mile from the bridge. The amount expended on this work during the year ending June 30, 1892, was $5,846.41.

The proposed channel is incomplete and, until the lock at the head of the bayou is built, of but little service to navigation and liable to deteriorate.

In 1890 $100,000 was appropriated for continuing the improvement. Of this sum $60,000 was allotted for bank protection at the mouth. A project for the expenditure of the remainder by commencing work upon the lock was presented, but as the lock proposed by a Board of Engineer officers was estimated to cost $700,000, the $42,169.28 available July 1, 1892, has been held for increase by further appropriation by Congress.

The money statement following is for the entire work on Bayou Plaquemine, the amounts for securing the mouth of the bayou from further caving (page 223) being included:

July 1, 1891, balance unexpended	$132,063.43
June 30, 1892, amount expended during fiscal year	58,776.34
July 1, 1892, balance unexpended	73,287.09
Amount appropriated by act approved July 13, 1892	150,000.00
Amount available for fiscal year ending June 30, 1893	223,287.09
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	1,358,250.00

(See Appendix S 6.)

7. *Bayou Courtableau, Louisiana.*—At the time of the adoption of the present project the back water from the Atchafalaya River formed a large sand deposit known as Little Devil Bar, at the mouth of the Courtableau.

The approved project of 1880 contemplated the closing of some runout bayous in order to confine the water in the Courtableau and cause its current to wash out the bar at its mouth; after this was accomplished, then to construct a timber lock and dam to give slack-water navigation to Washington, La. In 1883 the estimate was increased to $78,500, and provided for a masonry lock.

Up to June 30, 1891, the sum of $28,374.87 had been expended in closing runout bayous, with the effect of partially removing the bar.

In 1890 $2,200 was appropriated. With this money work was commenced September 8, 1891, and continued until November 20 of that year, using the Government plant and hired labor. During this time the dams at Bayous Cane, Mamzelle, and Big Fordoche were all repaired with piles and sheet piles, brush aprons being placed above and below them, and all were left in good condition. The sum of $2,406.83 has been expended on this improvement during the year ending June 30, 1892.

Little Devil Bar has washed out considerably under the influence of the dams so as to give a navigable depth at a stage of water in the Atchafalaya River 7 feet below the level at which navigation was interrupted in the summer of 1891, but it is considered doubtful if, with all the runout bayous closed, a channel navigable at low water can be maintained over this bar which, under any circumstances, will certainly form at each high water of the Atchafalaya.

The dams are in fair condition, but the older ones will require extensive repairs in another year.

The success of the dams so far built appears to warrant their maintenance, and the permanent closure of the remaining runout bayous. There seems to be sufficient water in the bayou to wash out the bar at its mouth, formed by the back water of the Atchafalaya, if it can be held within the banks which the closure of the runout bayous by dams appears to effect.

July 1, 1891, balance unexpended	$2,825.13
June 30, 1892, amount expended during fiscal year	2,406.83
July 1, 1892, balance unexpended	418.30

(See Appendix S 7.)

8. *Bayou Teche, Louisiana.*—Prior to the project for improvement this bayou was obstructed by snags, logs, and impending trees, but money having been appropriated the stream was thoroughly cleared of such obstructions from Port Barre down. The amount expended on this improvement to June 30, 1891, was $49,578.16.

Since the completion of this work in 1886 some further obstructions had found their way into the bayou, and in 1890 Congress appropriated $5,000 with which to accomplish their removal.

Work under this appropriation was commenced by hired plant October 12, 1891, and continued until December 10 of the same year. The extent of the improvement made during this time covers a distance of about 59 miles from St. Martinsville down, and has given much relief and satisfaction to the commerce of the bayou. The amount expended on this work during the year was $4,771.

The improvement of the Teche can not be considered as permanent, since sunken logs, fallen trees, and wrecks of coal boats are constantly forming obstructions which will require removal.

July 1, 1891, balance unexpended	$5,421,84
June 30, 1892, amount expended during fiscal year	4,771.00
July 1, 1892, balance unexpended	650.84

(See Appendix S 8.)

9. *Mouth and passes of Calcasieu River, Louisiana.*—Previous to any improvement there was but 3 feet depth in the Calcasieu Passes.

In 1874, 1883, and 1888 channels were dredged through the bars in Calcasieu Lake, or at what is known as the passes of Calcasieu River. As no permanent system of revetment was employed the dredged channels were soon obliterated.

In 1888 an appropriation of $10,000 for continuing this improvement was made, but as at least $150,000 will be required to give anything like a permanent channel through the bars, the money has been held for future consideration.

In 1890 $75,000 was appropriated for the improvement of the mouth of the Calcasieu River, but as the work of jetty construction proposed was in an exposed locality the amount was not deemed sufficient with which to commence operations economically, and it has consequently been held for future increase.

The early construction of a secure channel through the bars in Calcasieu Lake is urgently needed, as it will give water transportation for the products of the mills on Calcasieu River, and result in a saving to the consumers of about $40,000 annually on this item alone. The improvement of the mouth of the river will afford a harbor of refuge and be an extension of the foregoing improvement.

Up to the close of the fiscal year ending June 30, 1891, there had been expended $19,245.31 on this stream.

July 1, 1891, balance unexpended	$84,935.40
July 1, 1892, balance unexpended	84,935.40
Amount appropriated by act approved July 13, 1892	100,000.00
Amount available for fiscal year ending June 30, 1893	184,935.40
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	425,000.00

(See Appendix S 9.)

10. Harbor at Sabine Pass, Texas.—Originally the bar obstructing the entrance to the harbor of Sabine Pass had not 6 feet of water upon it. In 1878 and 1880 channels from 12 to 16 feet were dredged through it, but they soon filled up. In 1882 a project was approved for the improvement of the entrance by constructing jetties and dredging, if necessary. The estimated cost of the improvement was $3,177,606.50.

Since the approval of this project there has been appropriated $1,098,750. A total of $1,120,422.44 had been expended to June 30, 1891, of which sum $800,422.44 was expended under the present project.

The east jetty has a total length of 17,100 feet; the outer 450 feet is foundation work only. A section of this jetty at the outer end, 240 feet long, was given a width of 112 feet at the foundation, and was capped with rock weighing from 1 to 3 tons. Its crest was 4½ feet above mean low water.

The west jetty is 9,500 feet long. Its outer end lacks about 4,000 feet of being abreast of the outer end of the east jetty; 2,500 feet of this jetty is, properly speaking, but foundation work.

The work of raising the jetties to 2 feet above mean high water was commenced in August, 1891, under contract approved May 27, 1891, and has been continued up to date. The east jetty has been raised to this height, with the exception of about 3,215 feet, and the west jetty with the exception of 4,374 feet.

Without any disturbance of the bottom, so as to assist the eroding action of the current, a very favorable improvement in the deepening of the pass has occurred, notwithstanding the incomplete state of the work. A vessel drawing 14.1 feet entered the pass safely. The results so far obtained are very encouraging.

The amount expended on this work during the year ending June 30, 1892, was $199,426.04.

July 1, 1891, balance unexpended		$298,327.56
June 30, 1892, amount expended during fiscal year		199,426.04
July 1, 1892, balance unexpended		98,901.52
July 1, 1892, outstanding liabilities	$43,847.59	
July 1, 1892, amount covered by uncompleted contracts	39,009.97	
		82,857.56
July 1, 1892, balance available		16,043.96
Amount appropriated by act approved July 13, 1892		350,000.00
Amount available for fiscal year ending June 30, 1893		366,043.96
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		1,728,856.50

(See Appendix S 10.)

11. Sabine River, Texas.—When the improvement of the river was commenced there was a depth of 3½ feet on the bar at its mouth, and also above the town of Orange. Logs, snags, etc., above here interfered with navigation. To June 30, 1889, there had been appropriated for this work $34,700, of which $30,760.39 had been expended.

In 1880 a channel 6 feet deep and from 70 to 100 feet wide was dredged through the bar. In 1881 several small cuts, to avoid bends obstructed with logs, were made above Orange.

An examination above Orange showed many snags in parts of the channel, and a project was prepared and contract entered into for the expenditure of the remaining balance in closing both branches of Old River at the head of the Narrows with pile, brush, and earth dams, to throw all the water into the useful channel, and removing the obstructions, such as snags, overhanging trees, etc.

The smaller Old River channel was closed, and most of the piles driven for the larger dam, when a sudden rise in the river washed out many of the piles in the latter. The river remaining so high that satisfactory work could not be done, the contract was extended to the next low-water season.

Work was resumed in September, 1890, and the dams finished, as projected, in December following, completing the project.

The dredged channel over the bar at the mouth is somewhat obstructed by snags, logs, etc., but the depth is now sufficient for the present demands of commerce.

The amount expended on the improvement of this river to June 30, 1891, was $34,613.12.

After the obstructions in the river between its mouth and Sudduths Bluff are removed, about $2,000 will be required each year to keep the river in navigable condition.

July 1, 1891, balance unexpended	$86.88
July 1, 1892, balance unexpended	86.88
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,086.88
Amount (estimated) required for completion of existing project	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix S 11.)

12. Neches River, Texas.—Before this river was improved the bar at its mouth had only 3 feet of water over it, and navigation was obstructed between Yellow Bluff and Bevilport by snags and fallen trees.

The project adopted for the improvement of this river called for the dredging of a channel over the bar at its mouth and the removal of obstructions from the river between Yellow Bluff and Bevilport. To June 30, 1891, $33,000 had been appropriated for this work, of which $28,842.16 had been expended.

In 1880 a channel was dredged through the bar at the mouth of the river 5 feet deep and 30 to 60 feet in width. In 1882 the river between Yellow Bluff and Bevilport was cleared of obstructions.

The bar at the mouth had again shoaled, so that at extreme low water there was only a navigable depth of about 3 feet. The channel was again dredged to a depth of 5 feet by the Government dredge, which had been at work at Calcasieu Pass, and the work was completed in April, 1889, since which time no work has been done.

The improvement will not be permanent, as the bar will re-form.

July 1, 1891, balance unexpended	$4,157.84
July 1, 1892, balance unexpended	4,157.84

(See Appendix S 12.)

13. Removing sunken vessels or craft obstructing or endangering navigation.—The removal of the wreck of the British bark *Bruce*, sunk in Ship Island Harbor, Mississippi, in December, 1890, was commenced, under contract with the Alabama Dredging and Jetty Company for the sum of $1,490, on June 19, 1891.

The removal was completed on August 1, 1891.

The wreck was blown to pieces with dynamite, and it is believed that, through inexperience, the contractors lost something like $1,000 in carrying out the work. Nothing of value was recovered from the wreck.

The total cost of removing this wreck was $1,764.83, of which the sum of $1,666.38 was expended during the year just closed.

Sunken coal barge in Bayou Teche, Louisiana.—On March 5, 1892, it was reported that a coal barge had sunk in Bayou Teche, near Franklin, La., and formed an obstruction to the navigation of this stream.

Its removal was authorized March 28, 1892, but owing to high water nothing further has been done.

(See Appendix S 13.)

EXAMINATION, MADE IN COMPLIANCE WITH PROVISIONS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Sabine River, Texas, from where said river empties into Sabine Lake, to Sudduths Bluff, on said Sabine River*, was made by local engineer in charge, Maj. Quinn, and report thereon submitted through Col. C. B. Comstock, Corps of Engineers, Division Engineer, Southwest Division. It is the opinion of Maj. Quinn, and of the division engineer, based upon the facts and reasons given, that this locality is worthy of improvement. The report of the preliminary examination containing sufficient information to indicate to Congress the probable cost of the work required, no further survey appears to be necessary at this time. The work proposed contemplates the removal of snags between Sabine Lake and Sudduths Bluff, at an estimated cost of $10,000. After the snags are removed $2,000 will be required annually to keep the river in good condition. The report was transmitted to Congress and printed as House Ex. Doc No. 20, Fifty-second Congress, first session. (See also Appendix S 14.)

SECURING MOUTH OF BAYOU PLAQUEMINE, LOUISIANA, FROM FURTHER CAVING, AND REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION IN MISSISSIPPI RIVER BELOW NEW ORLEANS, LOUISIANA.

Officer in charge, Capt. John Millis, Corps of Engineers; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. Securing mouth of Bayou Plaquemine, Louisiana, from further caving.—Bayou Plaquemine was formerly an outflowing branch of the Mississippi River, but on account of its tendency to enlarge and because of apprehensions that the channel of the main river might be deteriorated thereby, the levee system on the west bank of the Mississippi was carried across the head of the bayou in 1865. It is now proposed to improve and deepen the bayou and establish navigable connection between it and the Mississippi by a system of locks at the head of the bayou.

The west bank of the Mississippi at the entrance of this bayou was formerly subject to rapid caving, threatening the site of the proposed locks. The project adopted for the prevention of this caving along the west bank of the Mississippi contemplates the construction of a system of submerged spur dikes, built of timber, brush, and stone. They run out at right angles to the general direction of the bank line and are placed at intervals of about 900 feet.

Up to the close of the fiscal year ending June 30, 1891, there had been expended $49,699.26 on this work. Two of the dikes had been finished and the caving had been stopped in the vicinity of the completed work.

During the past year necessary repairs were made to dike No. 1, and three more dikes, Nos. 3, 4, and 5, were completed. The completed work of protection now extends to a distance of 2,500 feet above, and 1,500 feet below the site of the proposed locks, and within this distance the caving of the bank has been arrested.

During the fiscal year the net sum of $52,929.93 was expended on this work, leaving an available balance July 1, 1892, from funds allotted to this improvement, of $31,117.81. The money statement is consolidated with that for improvement of Bayou Plaquemine, Louisiana, page 219.

(See Appendix T 1.)

2. Removing sunken vessels or craft obstructing or endangering navigation in Mississippi River, below New Orleans, Louisiana.—The wreck of an old dry dock lying in Mississippi River off Point Celeste, about 42 miles below New Orleans, was blown up with dynamite on hand, without extra expense, and no longer obstructs navigation.

(See Appendix T 2.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN TEXAS.

Officer in charge, Maj. Charles J. Allen, Corps of Engineers, with Lieut. William C. Langfitt, Corps of Engineers, under his immediate orders; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. Entrance to Galveston Harbor, Texas.—The obstructions to deep-water navigation at this harbor have been the outer and inner bars. On the former the natural depth was 12 feet and on the latter about 13 feet, both at mean low tide.

The present project for improvement at this locality was adopted in 1874, modified in 1880, and again modified in 1886, the object being to deepen the channels so as to admit sea-going vessels of the deepest draft. The projects prior to 1874 related to dredging operations on a small scale.

The projects of 1874 and 1880 contemplated construction of jetties to deepen the channels on the bars; the former with a view to a depth of 18 feet. The modification of 1886 was with a view to a possible depth of 30 feet by means of jetties, to be supplemented, if need be, by dredging. These jetties to be of rock and to be built to a height of 5 feet above mean low tide. The cost of the modification of 1886 (the present project) was estimated as $7,000,000.

The total amount expended under the foregoing plans to include June 30, 1891, was $2,273,920.90, in addition to which there was expended $100,000, subscribed by the city of Galveston, in 1883. It has resulted in a depth of 13¼ feet in the channel on the outer bar at mean low tide, and a depth of 21 feet where the inner bar was.

The amount expended during the past fiscal year was $438,922.63.

It has resulted in maintaining 13½ feet on the outer bar and 21 feet where the inner bar was.

The work during the past fiscal year has been confined to extension of the south jetty. The extension consists of 4,600 linear feet of completed and 2,923 linear feet of uncompleted jetty, a total of 7,523 feet. The total of work done on this structure since operations upon it began in 1887 is represented by 26,923 feet of jetty, of which 24,000 feet is completed and 2,923 uncompleted.

The appropriation asked for the fiscal year ending June 30, 1894, is to be mainly applied towards construction of the projected north jetty.

July 1, 1891, balance unexpended		$1,104,079.10
June 30, 1892, amount expended during fiscal year		438,922.63
July 1, 1892, balance unexpended		665,156.47
July 1, 1892, outstanding liabilities	$19,838.72	
July 1, 1892, amount covered by uncompleted contracts	618,207.64	
		638,046.36
July 1, 1892, balance available		27,110.11
Amount appropriated by act approved August 5, 1892		450,000.00
Amount available for fiscal year ending June 30, 1893		477,110.11
Amount (estimated) required for completion of existing project		4,650,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		1,000,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix U 1.)

2. *Ship channel in Galveston Bay, Texas.*—This is a channel dredged by the United States Government from Bolivar Channel to Morgan Cut, the latter terminating at a point 4.8 miles from Morgan Canal, which is an excavation across Morgan Point at the mouth of San Jacinto River. Morgan Cut and Morgan Canal are works executed by the Buffalo Bayou Ship-Channel Company, chartered under the laws of Texas.

The natural depth on the line of the Galveston Bay Ship-Channel averaged 8½ feet at mean low tide, with a depth at some places of but 7 feet.

The project for this improvement was adopted in 1871 and modified in 1877, the object being to excavate and maintain a channel 12 feet deep and 100 feet wide at bottom, through Galveston Bay from Bolivar Channel to Morgan Cut, a distance of 18.9 miles.

Work upon the channel, which had been suspended in 1883, was resumed in February, 1888, and by July 20, 1889, a channel of 12 feet least depth and 100 feet width at bottom had been excavated to Morgan Cut.

No dredging has been done since July, 1889.

The total amount expended to include June 30, 1891, was $536,228.43. By that date the channel had shoaled so that its ruling depth was 9 feet.

The amount expended during the past fiscal year was $4,602.73, mostly in repairs of beacons and in survey.

The ruling depth now is 8.6 feet.

The work of improvement of the ship channel having, in July, 1889, reached the point in the bay at which the southern extremity of Morgan Cut is located, the officer in charge, under instructions from this office, called upon the Buffalo Bayou Ship-Channel Company to execute its agreement of January 22, 1881, to transfer to the United States its works at Morgan Point. Congress, by act approved September 19, 1890, provided for the appointment of a commission of United States engineers to ascertain the value of any portion of the channel from Bolivar Channel to the point where the San Jacinto River enters what is known as Morgan Canal, which might have been constructed by the Buffalo Bayou Ship-Channel Company, the amount so ascertained and certified to be correct by the Secretary of War to be paid to the ship-channel company out of any money in the Treasury not otherwise appropriated. The report of the commission was made December 4, 1890, and approved and forwarded to the proper Department for payment in January following. On May 4, 1892, payment having been made for the works, the latter were taken possession of for the Government and made free to navigation.

The acquisition of the works at Morgan Point added to the ship channel in Galveston Bay 4.8 miles of cut in the bay and 3,347 linear feet of canal across Morgan Point. The ruling depth in the cut is 7½ feet; the depth in the canal is in excess of 17 feet. The addition of 5.43 miles of artificial channel to the Ship Channel in Galveston Bay rendered necessary a revision of the estimate for securing and maintaining throughout a least depth of 12 feet. The amount of the revised estimate is given in the full report of the officer in charge.

The project is not capable of permanent completion, it being estimated that the sum of $100,000 annually will be required to maintain the channel after it has been fully excavated to the required width and depth.

July 1, 1891, balance unexpended	$50,271.57
June 30, 1892, amount expended during fiscal year	4,602.73
July 1, 1892, balance unexpended	45,668.84
July 1, 1892, outstanding liabilities	95.69
July 1, 1892, balance available	45,573.15
Amount appropriated by act approved July 13, 1892	40,000.00
Amount available for fiscal year ending June 30, 1893	85,573.15
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	269,675.44

(See Appendix U 2.)

3. *Trinity River, Texas.*—The natural channel on the bar at the mouth was narrow and shoal. The project for improvement adopted in 1873 consisted principally in dredging. Between 1885 and 1889 no work was done and the channel which had been deepened in 1885 to 5½ feet had shoaled to 3 feet 2 inches. The project was modified in 1889, the modification principally consisting in parallel timber jetties to effect the required deepening to 6 feet on the bar. The total expended to include June 30, 1891, was $52,822.21, resulting in a depth of 3 feet 6 inches on the bar and straightening the channel. The amount expended during the past fiscal year was $3,297.47. One jetty has been nearly completed. It has maintained the depth of 3 feet 6 inches.

July 1, 1891, balance unexpended	$4,177.79
June 30, 1892, amount expended during fiscal year	3,297.47
July 1, 1892, balance unexpended	880.32
July 1, 1892, outstanding liabilities	86.00
July 1, 1892, balance available	794.32
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	10,794.32

Amount (estimated) required for completion of existing project	$22,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix U 3.)

4. *Cedar Bayou, Texas.*—A survey of this locality, with a view to removal of the bar at the mouth of the bayou, was made in 1889. The natural depth on the bar was 3 feet at mean low tide. The cost of improvement to afford a depth of 5 feet was estimated as $18,150, which sum was appropriated by act of September 19, 1890. This sum was applied during the past fiscal year to dredging and protection of the excavated channel by walls of brush and stone mattress, resulting in a channel 1,840 feet long and 64 feet wide with ruling depth of 5 feet over the distance dredged.

July 1, 1891, balance unexpended	$18,150.00
June 30, 1892, amount expended during fiscal year	13,258.22
July 1, 1892, balance unexpended	4,891.78
July 1, 1892, outstanding liabilities	2,918.10
July 1, 1892, balance available	1,973.68
Amount appropriated by act approved July 13, 1892	14,000.00
Amount available for fiscal year ending June 30, 1893	15,973.68

(See Appendix U 4.)

5. *Buffalo Bayou, Texas.*—The channel between the city of Houston and Simms Bayou, a distance of 11 miles, the extent of bayou under improvement, was, in its natural condition, narrow and tortuous and the natural depth in many places was not more than 6 feet. The project for improvement was adopted in 1881, the object being to straighten the channel and to widen it to 100 feet and to deepen it to 12 feet; also to remove such snags, stumps, and overhanging trees as obstructed navigation. The total amount expended to June 30, 1891, was $155,700.36. It resulted in clearing the channel of the most prominent stumps, snags, and overhanging trees, in easing most of the bends, and in removing such shoals as obstructed a 7-foot navigation. The amount expended during the past fiscal year was $10,103.63. It has resulted in further easement of bends and in still further relieving the channel and bends of obstructions. The obstructions are renewed in more or less degree every year, through action of floods. The project is not capable of permanent completion.

July 1, 1891, balance unexpended	$13,049.64
June 30, 1892, amount expended during fiscal year	10,103.63
July 1, 1892, balance unexpended	2,946.01
July 1, 1892, outstanding liabilities	30.00
July 1, 1892, balance available	2,916.01
Amount appropriated by act approved July 13, 1892	25,000.00
Amount available for fiscal year ending June 30, 1893	27,916.01
Amount (estimated) required for completion of existing project	191,549.75
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix U 5.)

6. *Harbor at Brazos Santiago, Texas.*—In its natural state the channel over this bar was shifting, and its depth varied from 6 to 8 feet. The present (original) project for its improvement was adopted in 1881,

the object being to fix the position of the channel over the bar at the entrance and to deepen it. The total amount expended to June 30, 1891, was $189,608.59, besides an appropriation of $6,000 in 1878, applied to removing a wreck. It has resulted in no useful effect upon the bar, and the works heretofore constructed have practically disappeared. The amount expended during the past fiscal year was $190. It was applied to the keeping of a record of commercial statistics and incidental engineering expenses. The officer in charge considers $600,000 as the least amount that should be available before beginning construction of the jetties. Taking into consideration the balance available ($57,686.41), the sum of $542,000, in round numbers, would be needed to make up the amount named.

July 1, 1891, balance unexpended	$57,891.41
June 30, 1892, amount expended during fiscal year	190.00
July 1, 1892, balance unexpended	57,701.41
July 1, 1892, outstanding liabilities	15.00
July 1, 1892, balance available	57,686.41
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	1,071,090.22

(See Appendix U 6.)

EXAMINATIONS AND SURVEY, MADE IN COMPLIANCE WITH PROVISIONS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Brazos River, Texas, from its mouth to Waco*, was made by the local engineer in charge, Maj. Allen, and report thereon submitted through Col. C. B. Comstock, Corps of Engineers, Division Engineer, Southwest Division. It is the opinion of Maj. Allen and of the division engineer, based upon the facts and reasons given, that this locality is not worthy of improvement. This opinion being concurred in by me, no further survey was ordered. The reports were transmitted to Congress and printed as House Ex. Doc. No. 63, Fifty-second Congress, first session. (See also Appendix U 7.)

The required preliminary examination of *West Galveston Bay, Texas, from Christmas (Christians) Point, with a view of reopening the channel through West Bay*, was made by the local engineer in charge, Maj. Allen, and report thereon submitted through Col. C. B. Comstock, Corps of Engineers, Division Engineer, Southwest Division. It is the opinion of Maj. Allen and of the division engineer, based upon the facts and reasons given, that this locality is worthy of improvement. This opinion being concurred in by me, Maj. Allen was charged with and has completed its survey and submitted report thereon. The proposed improvement contemplates straightening and slightly deepening the channels and removing the points bordering them by dredging, so as to afford a least width of 200 feet and depth of 3½ feet in West Bay between the railroad bridges, near Galveston, and San Luis Pass, and a least width of 100 feet and depth of 3 feet in Oyster Bay along Christmas Point, and marking the channel by beacons. The total cost of this work is estimated at $28,998.80. The reports were transmitted to Congress and printed as House Ex. Doc. No. 22, Fifty-second Congress, first session. (See also Appendix U 8.)

WESTERN RIVERS.

IMPROVEMENT OF CERTAIN RIVERS AND WATER WAYS IN LOUISIANA, TEXAS, ARKANSAS, MISSISSIPPI, AND TENNESSEE, TRIBUTARY TO MISSISSIPPI RIVER; WATER GAUGES ON MISSISSIPPI RIVER AND ITS PRINCIPAL TRIBUTARIES.

Officer in charge, Capt. J. H. Willard, Corps of Engineers; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Red River, Louisiana and Arkansas.*—This improvement was begun in 1828, and appropriations aggregating $535,765.50 were made between 1828 and 1852. Between 1841 and 1852 no appropriation was made, and a longer interval elapsed between 1852 and 1872, during which the results of former work were lost.

The present improvement, from Fulton, Ark., to mouth of Atchafalaya River, commenced in 1872, at which time the upper river was closed by the great raft, extending from Carolina Bluffs, 33 miles above Shreveport, La., upstream 32 miles to within 4 miles of the Louisiana and Arkansas line, which was added to by each flood. The falls at Alexandria were impassable at low stages. Navigation below Shreveport was affected seriously by the gradual enlargement of Tones Bayou Outlet, 19 miles below Shreveport, which depleted the main channel, and the river was greatly obstructed by snags, sunken logs, wrecks, and leaning trees throughout its entire length.

The project of 1872 contemplated removing the great raft and closing Tones Bayou. Subsequently this project was enlarged to include the removal of jams, snags, wrecks, leaning timber, etc.; opening and enlarging the channel through the falls at Alexandria, La.; deepening the channel at shoal places, and closing the Sale and Murphy Outlet, on the right bank, 66 miles above Shreveport, in order to improve and keep navigation open from Fulton to the Atchafalaya. Also to protect the bank at Alexandria from erosion, and to make a thorough and comprehensive survey from Fulton to the mouth on which to base plans and estimates for permanent improvement.

The amount expended from 1872 to June 30, 1891, was $926,024.52 (including outstanding liabilities of $429.46), resulting in great benefit to navigation. A channel was opened through the great raft in 1873, and subsequent operations, aided by the current, secured a greater width and depth throughout the entire reach, with a channel way constantly widening and scouring, with but little water diverted from the river proper except at flood stages. Moderate estimates, made in 1872, showed that the removal of this obstruction alone resulted in an annual saving of $150,000 to the planting interest above the raft, besides relieving to a great extent not less than 25,000 acres of productive lands from overflow. The removal of obstructions from the channel, clearing the banks, and prompt breaking of all jams, and keeping the drift in motion during high water, prevented renewal of the raft. No work has been done for the closure of Tones Bayou since 1882, when the dam under construction was destroyed. This outlet is filling up gradually with drift, and this, in connection with the work done in the old raft region above and in the narrow river below, is causing the main channel to widen and scour. The rock excavation and dam at the falls of Alexandria were completed in 1885, increasing the period of navigation about two months, and as a general thing permitting boats to pass the falls the year round. The dam and training wall built at Alexandria in 1884–'85 for protecting the bank accomplished the purpose for which intended. The removal of snags and clearing the banks for the general improvement of the river were not begun until 1878, but since 1885 operations were confined chiefly to that class of work. The survey of Red River was carried from Fulton, Ark., down to Grand Bend, La., near Alexandria, a distance of 406 miles, and was connected with the Mississippi by precise levels along the railroad from Shreveport to Delta, La.

In the past fiscal year the removal of obstructions was continued with great benefit to navigation. Snag boats worked over the entire river from Fulton to the Atchafalaya, nearly all of which was gone over twice, and narrow portions below Rush Point to Shreveport and between Tones Bayou and Knox Point were worked over three and four times. During the prolonged season of low water in the summer and fall of 1891 the entire plant available was employed in removing obstructions from the channel, and this work resulted in immediate benefit to low-water navigation. The Sale and Murphy Outlet was closed effectually by a heavy earthen dam which was completed in November, 1891, and resisted the flood of May, 1892, the highest of record, without sustaining serious damage. Fieldwork of the survey was carried from Grand Bend down to the mouth of the river and suspended in February, 1892, after which work on the maps and notes was continued to the end of the year. The estimated cost of completing the survey in accordance with the project is $97,000.

The amounts expended during the past year were:

For general improvement	$32,473.18
For work at Alexandria	454.00
For Little River from Scopini Cut-Off to Knox Point	645.40
For closing Sale and Murphy Outlet	4,889.92
For survey of Red River	23,249.31
Total	61,711.81

July 1, 1891, balance unexpended	104,404.94
June 30, 1892, amount expended during fiscal year	61,711.81
July 1, 1892, balance unexpended	42,693.13
July 1, 1892, outstanding liabilities	107.12
July 1, 1892, balance available	42,586.01
Amount appropriated by act approved July 13, 1892	145,000.00
Amount available for fiscal year ending June 30, 1893	187,586.01

(See Appendix V 1.)

2. *Red River above Fulton, Arkansas.*—The project for this improvement, adopted in 1886, contemplated removing snags, drift, overhanging trees, etc., above Fulton to the mouth of Kiamichi River, about 138 miles, to give reasonably safe navigation at high and medium stages.

The amount expended to June 30, 1891, was $11,773.82, with which a small hand-propelled snag boat was built in the fiscal year 1887, at a cost of $4,000, and employed during the succeeding two years in removing obstructions. In the fiscal year 1891 the snag boat was sold to the work of improving Red River, Louisiana and Arkansas, for $1,500, and the proceeds of the sale, with the appropriation of 1890, were applied to going over the work and removing snags, drift, and leaning trees, practically completing the project.

July 1, 1891, balance unexpended	$226.18
June 30, 1892, amount expended during fiscal year	5.44
July 1, 1892, balance unexpended	220.74
July 1, 1892, outstanding liabilities	1.29
July 1, 1892, balance available	219.45
Amount appropriated by act approved July 13, 1892	3,500.00
Amount available for fiscal year ending June 30, 1893	3,719.45

(See Appendix V 2.)

3. *Ouachita and Black rivers, Arkansas and Louisiana.*—The improvement of Ouachita River commenced in 1871. Black River, the connecting stream between Ouachita and Red rivers, was added under the same head of appropriation by the act of 1884. The original project contemplated im-improvement by a system of locks and dams, but was abandoned on account of its cost as compared with the amount of commerce then reported. The present project contemplates removing snags, logs, wrecks, leaning timber, etc., and the improvement of shoal places between Camden, Ark., and the mouth of Black River, a distance of 341 miles. No estimate of cost is given, as the nature of the work requires that it be continuous.

The total amount expended to June 30, 1891 (including outstanding liabilities of $241.67), was $329,965.12, of which $216,377.25 was applied to operations under the project of 1874. An iron-hull snag boat was purchased in 1875 and repaired with a new steel bottom in 1886, and a small wooden snag boat was purchased in 1888. From 1875 to the end of the fiscal year 1891, operations were carried on whenever funds were available, and consisted chiefly of the removal of wrecks, snags, logs, and tree slides from the channel, and cutting leaning timber, though an increased depth was obtained at some of the shoals by building stone and brush wing dams.

In the past fiscal year operations with a large snag boat were continued from Logtown, on Lower Ouachita, to mouth of Black River, July 1–17, 1891, after which it was withdrawn. The chopping party, which commenced operations at Camden in November, 1890, continued downstream to Alabama Landing, 126½ miles below Camden, where work was suspended December 31, 1891, on account of high water, and the stages continued too high for further work to the end of the year. The work of this party consisted of cutting leaning timber into short lengths, giving special attention to points and bends, girdling trees for some distance back from the river, and removing obstructions from the channel as far as practicable with explosives and hand capstan; and, as it was done at low stages of water, resulted in much benefit to navigation of the upper river.

Since the project for locks and dams was abandoned three examinations have been ordered and made with a view to slack-water navigation, the last in 1889, and the reports on all agree that for the present work should continue under the adopted project.

July 1, 1891, balance unexpended	$12,776.55
Amount received on account of overpayments in June, 1891	145.00
	12,921.55
June 30, 1892, amount expended during fiscal year	10,872.22
July 1, 1892, balance unexpended	2,049.33
July 1, 1892, outstanding liabilities	13.17
July 1, 1892, balance available	2,036.16
Amount appropriated by act approved July 13, 1892	40,000.00
Amount available for fiscal year ending June 30, 1893	42,036.16

(See Appendix V 3.)

4. *Bayou D'Arbonne, Louisiana.*—The project for this improvement was adopted in 1884, and contemplates removing snags, logs, wrecks, leaning timber, etc., obstructing navigation from Stein Bluff, on the Corney Branch, to the mouth of D'Arbonne, 42½ miles, at an estimated cost of $15,000.

The amount expended to June 30, 1891, was $10,109.49. Before the improvement commenced the bayou was navigable from six to seven months of the year. The work done extended the period of navigation fully one month, enabled boats of double the capacity to make quicker time than those used formerly, with greater safety, and reduced freight rates one-half.

In the past fiscal year operations extended from Stein Bluff to the mouth, consisting chiefly of cutting and girdling leaning timber, cutting stumps, shore snags, and logs along the banks, and removing snags, logs, and stumps from the channel with explosives and blocks and tackle. The bayou was at a low stage while operations were in progress, and effective work was done, enabling boats to run at a lower stage of water, and to make the round trip in three to four hours less time.

The work is not permanent, as new obstructions are added from time to time, but with the balance of the original estimate in a single appropriation ($4,000) it can be completed to Stein Bluff so thoroughly as not to require attention for several years.

Within the last few years navigation of the Corney Branch has been extended up to Cobb Landing, 16½ miles above Stein Bluff.

July 1, 1891, balance unexpended	$890.51
June 30, 1892, amount expended during fiscal year	765.45
July 1, 1892, balance unexpended	125.06
Amount appropriated by act approved July 13, 1892	4,000.00
Amount available for fiscal year ending June 30, 1893	4,125.06

(See Appendix V 4.)

5. *Bayou Bartholomew, Louisiana and Arkansas.*—This improvement commenced in 1881, the project contemplating the removal of snags, logs, wrecks, leaning timber, etc., obstructing navigation between Baxter, Ark., and the mouth, about 150 miles.

The amount expended to June 30, 1891, was $30,753.44, and the outstanding liabilities were $347.60. With these amounts operations extended over the entire portion of the bayou included in the project, and some of the most obstructed parts were worked over two and three times, but at no time was the amount available sufficient to do the work thoroughly as projected. However, the work performed at intervals has benefited navigation to a great extent. Before the improvement commenced three months was the average duration of the navigable season; now there is better navigation for about six months, and boats of double the capacity make trips with greater safety in half the time; and rates of freight are reported to have been reduced 50 per cent.

The work begun at Portland, Ark., in May, 1891, was continued during the fiscal year from Hughes Place, La., down to the mouth, where operations suspended August 14, 1891, resulting in widening the channel from 20 to 30 feet, enabling steamboats to navigate on from 2 to 3 feet lower stage, and to make the round trip in twelve to fifteen hours' quicker time.

July 1, 1891, balance unexpended	$2,246.56
June 30, 1892, amount expended during fiscal year	1,898.46
July 1, 1892, balance unexpended	348.10
July 1, 1892, outstanding liabilities	.92
July 1, 1892, balance available	347.18
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,347.18

(See Appendix V 5.)

6. *Bayou Bœuf* (*Bœuf River*), *Louisiana.*—The project for improving this bayou was adopted in 1881, and contemplated removing snags, logs, leaning timber, etc., obstructing navigation between Wallace Landing and the mouth, about 152 miles. Three outlets near Point Jefferson, La., were examined in 1884 and their closure recommended.

The amount expended to June 30, 1891, was $26,028.68, enabling steamboats to run to Point Jefferson, 19 miles below Wallace Landing, during high stages, with greater safety. The three outlets were closed in 1887 and 1888, and the work gave immediate benefit to navigation by confining the flow to its natural direction and scouring the bars below, but the dams were destroyed during the overflow from the Mississippi River in the spring of 1890. It is essential that they be rebuilt if navigation in the bayou is to be maintained. The estimated cost of this work is $12,000.

In the past fiscal year a chopping party worked from the mouth of the bayou up to a point 9½ miles above the Vicksburg, Shreveport & Pacific Railroad Bridge, September 28 to December 12, 1891. The water remained at a low stage during the entire period, and effective work was done, which will enable steamboats to navigate this part of the stream with greater safety at any stage high enough to pass the bars, without danger of knocking down chimneys, damaging upper works, or losing freight in the leaning timber, saving at least thirty-six hours' time on the round trip, and permitting navigation at a 2-foot less stage.

A small balance was reserved to remove jams of drift if necessary.

July 1, 1891, balance unexpended	$4,971.32
June 30, 1892, amount expended during fiscal year	4,666.39
July 1, 1892, balance unexpended	304.93
July 1, 1892, outstanding liabilities	22.54
July 1, 1892, balance available	282.39
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	10,282.39

(See Appendix V 6.)

7. *Tensas River and Bayou Macon, Louisiana.*—The project for improving Tensas River was adopted in 1881, and contemplated removing snags, logs, and leaning timber obstructing navigation between Dallas and its mouth, about 134 miles, at an estimated cost of $23,000. Bayou Macon, a tributary, was added under the same head of appropriation by act of 1884, and the project contemplated removing the same class of obstructions between Floyd and its mouth, about 98 miles, at an estimated cost of $17,000.

The amount expended to June 30, 1891, was $15,873.24, of which $7,529.25 had been applied to the Tensas and $8,343.99 to the Macon. The obstructions were removed as far as practicable with these amounts, and in Bayou Macon, the principal commercial branch, had resulted in improved navigation so as to shorten the time of steamboat trips twelve hours.

In the past fiscal year the wreck of the steamboat *H. J. Dickey* was removed from Bayou Macon, near Delhi, La., December 17, 1891, and December 29–January 12 a chopping party was employed in removing obstructions, chiefly in the channel, from the lower 40 miles of Bayou Macon. This work was stopped by high water the latter date, and continued high stages to the end of the year prevented its resumption.

July 1, 1891, balance unexpended	$5,126.76
June 30, 1892, amount expended during fiscal year	2,107.40
July 1, 1892, balance unexpended	3,019.36
July 1, 1892, outstanding liabilities	.38
July 1, 1892, balance available	3,018.98
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	8,018.98
Amount (estimated) required for completion of existing project	14,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix V 7.)

8. *Bayous Rondeway and Vidal, Louisiana.*—An appropriation of $1,000 was expended in the fiscal year 1889 in removing obstructions, chiefly leaning trees, from the canal and the part of Bayou Vidal remaining open between Lake Palmyra (an old bend of the Mississippi) and the line of levee north of the lake. After completion of this work, the canal was claimed as private property, and the owner issued notice that tolls would be collected from passing boats, and for this reason it was recommended that the old mouth of the bayou, which was obstructed by leaning timber and fallen timber and stumps, be reopened to save the steamboat interests from such imposition.

The act of 1890 appropriated $1,000 for this purpose, but owing to high stages of the Mississippi the work was not begun until the latter part of June, 1891, when a chopping party commenced operations which were completed July 31, 1891, consisting of the removal of snags and logs and felling leaning timber.

July 1, 1891, balance unexpended	$883.98
June 30, 1892, amount expended during fiscal year	882.87
July 1, 1892, balance unexpended	1.11
July 1, 1892, outstanding liabilities	.69
July 1, 1892, balance available	.42

(See Appendix V 8.)

9. *Big Black River, Mississippi.*—The original project for this improvement contemplated removing snags, logs, leaning timber, etc., obstructing navigation between Cox Ferry and the mouth, about 130 miles, at an estimated cost of $32,000.

The first appropriation, by act of 1884, $5,000, was applied to removing the principal obstructions for a distance of 75 miles above the mouth.

The next appropriation, by act of 1886, contained the proviso that no part of the appropriation should be used until the State of Mississippi caused the bridges below the Vicksburg and Meridian Railroad to be so constructed as not to obstruct navigation.

The act of 1890 removed the restriction contained in the act of 1886, and the project was modified to include only the portion of the river below the Baldwin Bridge. Work was commenced in January, 1891, and continued, whenever the stages of water were favorable, until June 18, 1891. The principal work done was between Baldwin and Ivanhoe ferries, a distance of about 20 miles.

July 1, 1891, balance unexpended	$264.77
June 30, 1892, amount expended during fiscal year	16.00
July 1, 1892, balance unexpended	248.77
July 1, 1892, outstanding liabilities	4.96
July 1, 1892, balance available	243.81
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,243.81

(See Appendix V 9.)

10. *Yazoo River, Mississippi.*—Work in this river was begun in 1873, and the project contemplated removing wrecks, snags, logs, leaning timber, etc., obstructing navigation the entire length of the river. New obstructions, caused by floods, sliding and caving banks, etc., are brought into the river every year, and no estimates for permanent improvement are given on this account.

The total amount expended to June 30, 1891, was $201,679.72 (including $23.69 outstanding liabilities on that date), part of which was applied to constructing the snag boat *Meigs*, the purchase of a pumping dredge, and to the survey of the mouth and lower river. Prior to improvement the river was obstructed by a large number of wrecks, snags, and leaning timber that limited the period of navigation. Nine of the steamboats sunk during the war of the rebellion were removed by contract in 1873–'74, and snag boats have operated since whenever funds were available, benefiting low-water navigation greatly, and keeping the river in navigable condition from head to mouth the year around.

In the past fiscal year the snag boat *Meigs* was employed during the low-water season in removing obstructions from the channel, and did effective work, putting the stream in good navigable condition, but as new snags and tree slides are brought in by every high stage of water operations will have to be continued for many years.

The shifting bar at the mouth of the river is the most serious obstruction to navigation, and boats that could navigate the principal streams of the Yazoo Valley system (about 800 miles) without hindrance are prevented at low stages from entering or leaving without lightening, and at times navigation across the bar is closed altogether. The act of 1890 directed that $5,000 of the appropriation for Yazoo River be used in making a survey from the Louisville, New Orleans and Texas Railway bridge to the mouth, to determine in what manner the mouth can be improved to permit free passage of vessels at all seasons of the year, and to include an investigation of the feasibility and advantage of making a new outlet for the river by way of Chickasaw Bayou, or otherwise, with an estimate of cost. This survey was begun in October, 1890, and continued until high water compelled suspension December 6, and the river remained high until September, 1891, when field work was completed. Maps and reports were prepared and submitted February 4, 1892. The report was transmitted to Congress and printed as House Ex. Doc. No. 125, Fifty-second Congress, first session (see also Appendix V 10). The improvement proposed contemplates the formation of a new outlet from the former mouth of Yazoo on Old River, through the deep water in Old River, across the low lands between Long and Barnett lakes to Lake Centennial, around the head of De Soto Island, along the front of Vicksburg, and entering the Mississippi River on the channel side at Kleinston. The total cost of this work is estimated at $1,500,000.

July 1, 1891, balance unexpended	$13,343.97
June 30, 1892, amount expended during fiscal year	10,263.40
July 1, 1892, balance unexpended	3,080.57
July 1, 1892, outstanding liabilities	7.33
July 1, 1892, balance available	3,073.24
Amount appropriated by act approved July 13, 1892	20,000.00
Amount available for fiscal year ending June 30, 1893	23,073.24

(See Appendix V 10.)

11. Tchula Lake, Mississippi.—This work commenced in 1881, and the project contemplated removing snags, logs, leaning timber, etc., obstructing navigation, to permit light-draft boats to enter the lake earlier in the season.

The amount expended to June 30, 1891, was $11,413.77, resulting in clearing the greater portion of the leaning timber from the banks, and in the removal of the main obstructions from the channel, giving greater safety to the passage of steamboats through the lake.

In the past fiscal year operations consisted of clearing the brush, which had grown so rapidly and to such extent that in many places the clear channel did not exceed 50 feet in width; cutting shore snags and logs, felling and girdling leaning timber on both banks, and removing snags from the channel. This work was carried from the head of the lake down to within 15 miles of the mouth.

July 1, 1891, balance unexpended	$3,586.23
June 30, 1892, amount expended during fiscal year	3,556.82
July 1, 1892, balance unexpended	29.41
July 1, 1892, outstanding liabilities	9.00
July 1, 1892, balance available	20.41
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	3,020.41

(See Appendix V 11.)

12. Tallahatchee River, Mississippi.—This improvement was begun in 1879, and contemplated removing snags, sunken logs, and leaning timber, obstructing low-water navigation below the mouth of Coldwater River, about 100 miles, and the removal of a wreck in the channel near the mouth. The estimated cost of the work was $40,000, if completed in two seasons.

The amount expended to June 30, 1891, was $35,468.98, of which $10,000 was required by law to be expended above the mouth of Coldwater (a part of the river in which there has been no navigation since the war, and which was not included in the project). The work done resulted in great benefit to navigation below Sharkey Landing, a distance of about 65 miles, enabling steamboats to run to that place the year round, while before the improvement commenced there was navigation for only about six months of the year. Little work was done above Sharkey, because the funds were not sufficient, and because until 1890 the steamboat interest reported that boats would not run above that landing, except to make occasional trips at high stages, when navigation was as good and about as safe as in the lower river. No benefit was derived from the work done in 1880, 1881 and 1882 above the mouth of Coldwater to Batesville, required by the appropriation acts, for the reason that there has been no trade in that part of the stream.

In the past fiscal year a snag boat was employed during the month of October in the lower 50 miles of river. The water was at a low stage and effective work was done. Operations were not resumed to the end of the fiscal year, as there were no funds available.

The original estimates were for completing this work in two seasons at a cost of $40,000, but the aggregate of the appropriations from 1879 to the end of the fiscal year 1892 was only $37,500, of which the law required $10,000 to be expended on a part of the stream not included in the project. New obstructions are brought into the river every year by sliding and caving banks, and the shifting and scouring of the channel exposes others or lodges them upon the bars.

July 1, 1891, balance unexpended	$2,031.02
June 30, 1892, amount expended during fiscal year	2,012.50
July 1, 1892, balance unexpended	18.52
July 1, 1892, outstanding liabilities	17.00
July 1, 1892, balance available	1.52
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,001.52
Amount (estimated) required for completion of existing project	7,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix V 12.)

13. Steele and Washington bayous, Mississippi.—The improvement of Steele Bayou was commenced under the act of 1884. Washington Bayou, about 7 miles long, which connects Steele Bayou with Lake Washington, was added by act of 1886. The project contemplates removing snags, stumps, drift, and leaning timber, to improve high-water navigation.

The amount expended to June 30, 1891, was $9,020.66, with which Steele Bayou was worked over twice from its source in Swan Lake to its mouth, and the obstructions in Washington Bayou were removed in 1886. This work resulted in greater ease and safety to steamboat navigation at high stages, but was by no means thorough on account of the small amounts appropriated.

In the past fiscal year work was carried from the mouth upstream about 22 miles before the available balance was exhausted.

Steamboat navigation in this stream was not commenced until 1879, and since the construction of a railroad through the country in 1884 it has fallen off until for several years the trade has amounted to little or nothing. The stream is navigable only when the Mississippi is high enough to fill the lower portion with backwater, and owing to the uncertainty of steamboat transportation there is no probability that the trade will revive. In view of the foregoing, no recommendation is made for continuing the work.

July 1, 1891, balance unexpended	$979.34
June 30, 1892, amount expended during fiscal year	966.67
July 1, 1892, balance unexpended	12.67
July 1, 1892, outstanding liabilities	.31
July 1, 1892, balance available	12.36
Amount appropriated by act approved July 13, 1892	2,500.00
Amount available for fiscal year ending June 30, 1893	2,512.36

(See Appendix V 13.)

14. Big Sunflower River, Mississippi.—Work in this river commenced in 1879. The project contemplated building wing dams to scour a channel from 3 feet to 40 inches deep at the bars, and the removal of snags, sunken logs, and leaning timber obstructing navigation.

The amount expended to June 30, 1891, was $56,196.07. Operations during the thirteen years extended over the navigable part of the river from Clarksdale to the mouth, though little was done above Faisonia since 1882, for the reason that it would have resulted in no benefit to commerce or navigation to clear the upper river and allow the lower portion to remain obstructed, the amounts appropriated at irregular intervals having been too small to permit work over the whole river. To obtain the greatest benefit with the means available, it has been the endeavor to keep the lower river open the year round, and to extend navigation higher as the work progresses. Steamboat men report that before the improvement commenced the river was navigable for very light boats about six months of the year; now it is navigable to Woodburn the year round, but difficult and dangerous at low stages on account of shoals, snags, and sunken logs. Larger boats are used, and make the round trip from Vicksburg (about 180 miles and return) in five days, while before the improvement it was unusual for a boat to make the trip under eight days. Freight rates are reported to be 50 per cent less. The lands along the river are being cleared and settled rapidly of late years, which is attributed in part to the improved navigation.

In the past fiscal year the small balance available was expended August 18–30 for the operation of a small snag boat, which worked over the river from the mouth up to within half a mile of Faisonia.

July 1, 1891, balance unexpended	$803.93
June 30, 1892, amount expended during fiscal year	739.04
July 1, 1892, balance unexpended	64.89
July 1, 1892, outstanding liabilities	.29
July 1, 1892, balance available	64.60
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,064.60

(See Appendix V 14.)

15. Big Hatchee River, Tennessee.—This work commenced in 1880. The project contemplated removing logs, snags, leaning timber, etc., to render the river navigable for light-draft boats throughout the year from the mouth to Bolivar, Tenn., about 240 miles.

Before work commenced navigation was virtually suspended by the obstructions. The amount expended to June 30, 1891, was $26,999.19, rendering the stream navigable for light boats from 7 to 9 months of the year.

In the past fiscal year a snag boat worked from the mouth upstream about 67 miles, where operations were suspended by high water.

July 1, 1891, balance unexpended	$5,000.81
June 30, 1892, amount expended during fiscal year	2,822.33
July 1, 1892, balance unexpended	2,178.48
July 1, 1892, outstanding liabilities	2.56
July 1, 1892, balance available	2,175.92
Amount appropriated by act approved July 13, 1892	3,500.00
Amount available for fiscal year ending June 30, 1893	5,675.92

(See Appendix V 15.)

16. Forked Deer River, Tennessee.—Work in South Fork of this river commenced in 1883. The act of 1888 added North Fork and main river under the general head improving Forked Deer River. The project contemplated removing snags, logs, leaning timber, etc., obstructing navigation in South Fork below Jackson, North Fork below Dyersburg, and the main stream from the forks to the Mississippi.

The amounts expended to June 30, 1891, were $12,500 for South Fork, $4,500 for North Fork, and $2,500 for the main river. With these expenditures the two forks were put in fairly good navigable condition, but no material benefit was gained in the main stream. Navigation of South Fork is carried on by flatboats, and before the improvement commenced about one boat in three was lost on account of the obstructions; now they make the trip in comparative safety and at less cost. The work in North Fork enabled boats to run at a stage 3 feet lower than formerly.

In the past fiscal year a light snag boat worked over the main river and North Fork until the funds were exhausted. This work resulted in a greater depth of clear channel between Dyersburg and the mouth, by the removal of snags and logs, and gave greater ease and safety for the passage of boats.

July 1, 1891, balance unexpended	$2,500.00
June 30, 1892, amount expended during fiscal year	2,496.25
July 1, 1892, balance unexpended	3.75
July 1, 1892, outstanding liabilities	1.20
July 1, 1892, balance available	2.55
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	3,002.55

(See Appendix V 16.)

17. Water-gauges on Mississippi River and its principal tributaries.—These gauges were designed to secure information from continuous records, with a view to protecting alluvial lands against overflow, improving navigation, and giving correct reports of the stages of water, for the benefit of river men and planters, and their establishment and the maintenance of daily observations was enjoined upon the Secretary of War by joint resolution of Congress approved February 21, 1871 (Statutes at Large, vol. 16, page 598).

The amount expended to June 30, 1891, was $86,886.40, with outstanding liabilities amounting to $211.87. Nineteen gauges were established originally, and under the portion of the joint resolution of 1871 authorizing gauges "at such other places as the Secretary of War may deem advisable," the following have been added, viz: At Nashville, Tenn., Cumberland River, in 1873; Shreveport, La., Garland, Ark., and Fulton, Ark., Red River, in 1890; and Donaldsonville, La., Mississippi River, in 1890. The gauge at Rock Island, Ill., was abandoned in 1879, and the one at Fort Leavenworth, Kans., in 1886, but a record at the latter place has been maintained by the Missouri River Commission.

There are now 22 gauges maintained under this work, and in addition to the extensions mentioned above the service has been improved very materially of late years. In 1881 bulletins were erected at the stations on the Mississippi for the purpose of giving passing steamboats the stage of water and indicating whether the river was rising, stationary, or falling, and in 1890 these were replaced by larger bulletins, and the old ones repaired and used in extending the service to the tributaries. Since February 1, 1887, the gauges have been read and bulletins posted twice a day to secure greater uniformity and accuracy; formerly they were read only once a day. Records of the readings have been published by the Mississippi River Commission to the end of the calendar year 1891.

July 1, 1891, balance unexpended	$247.31
Amount allotted for project for fiscal year ending June 30, 1892, approved July 17, 1891	5,100.00
	5,347.31
June 30, 1892, amount expended during fiscal year	5,319.33
July 1, 1892, balance unexpended	27.98
July 1, 1892, outstanding liabilities	27.92
July 1, 1892, balance	.06

(See Appendix V 17.)

18. *Survey of Cypress Bayou and the lakes between Jefferson, Texas, and Shreveport, Louisiana.*—This survey was ordered by river and harbor act of September 19, 1890, to ascertain whether the navigation of the bayou and lakes can be materially and permanently improved by the construction of locks and dams, and, if found practicable, the probable cost thereof.

The original estimates for the survey amounted to $12,000, but only $10,000 was appropriated, and owing to this insufficient amount and delays by high water the work was not completed. A report was submitted by Captain Willard, the local engineer in charge, February 6, 1892, stating the progress made in the conduct of the survey, and the necessity for further consideration and investigation of the subject, with the recommendation that the additional sum of $2,500 be provided to complete the work. This report was transmitted to Congress and printed as House Ex. Doc. No. 126, Fifty-second Congress, first session (see also Appendix V 18).

July 1, 1891. balance unexpended	$102.01
June 30, 1892, amount expended during fiscal year	96.00
July 1, 1892, balance unexpended	6.01
July 1, 1892, outstanding liabilities	4.98
July 1, 1892, balance available	1.03
Amount appropriated by act approved July 13, 1892	2,000.00
Amount available for fiscal year ending June 30, 1893	2,001,03

(See Appendix V 18.)

IMPROVEMENT OF ARKANSAS RIVER AND OF CERTAIN RIVERS IN ARKANSAS AND MISSOURI.

Officer in charge, Capt. H. S. Taber, Corps of Engineers; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Removing obstructions in Arkansas River.*—Prior to the first improvements in 1833, shifting sand bars, numerous driftpiles, and dangerous snags constituted the obstacles to navigation in the lower reaches, and gravel and rock shoals, with a few snags and many overhanging trees, constituted those of the upper. Except for a few special reaches, like the Fort Smith and Pine Bluff, the general plan of improvement has consisted in snagging operations, including the cutting of overhanging trees, in building wing dams to improve the shoals, and in surveys looking towards plans for its permanent improvement.

The appropriations to June 30, 1891, amount to $485,251.37. Of this sum there had been expended to June 30, 1891, $400,619.10.

During the fiscal year ending June 30, 1892, $10,327 was expended in snagging operations at or near low water.

July 1, 1891, balance unexpended	$12,344.46
June 30, 1892, amount expended during fiscal year	10,327.00
July 1, 1892, balance unexpended	2,017.46
July 1, 1892, outstanding liabilities	1.25
July 1, 1892, balance available	2,016.21
Amount appropriated by act approved July 13, 1892	20,000.00
Amount available for fiscal year ending June 30, 1893	22,016.21
Amount (estimated) required for completion of existing project annually Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	35,000.00

(See Appendix W 1.)

2. *Arkansas River.*—Work during the past season has been carried on under three different acts of Congress.

By the act approved August 5, 1886, $75,000 was appropriated, its distribution being indicated in the following words:

> Improving Arkansas River, Arkansas: Continuing improvement, $75,000, according to the plan and recommendations in Appendix V 13, Report of Chief of Engineers, 1885, pages 1601 to 1611; of which there are to be expended $8,000 at Pine Bluff, $13,000 at Fort Smith, and $10,000 at Dardanelle, or so much thereof under these sums, respectively, as may be necessary at those points.

This appropriation, except a small sum out of the $10,000 for Dardanelle, was expended prior to June 30, 1890; at Dardanelle the $10,000 was to be expended in erecting a permeable dike above and opposite the town in such a position as to remove the sand bar in front of the wharves.

By act of August 11, 1888, the sum of $150,000 was appropriated for the improvement of this river, under plan providing for the formation of a channel at least 200 feet wide and 6 feet deep at low water from Little Rock to the Mississippi River; and the formation of a channel 2 feet deep at low water and from 200 to 300 feet wide from Fort Gibson to Arkansas City, as contemplated in the Report of the Chief of Engineers for the year ending June 30, 1885, and in House Ex. Doc. No. 90, Forty-ninth Congress, first session, and authorized in the act approved August 5, 1886.

By act approved September 19, 1890, the sum of $180,000 was appropriated. The approved projects for the expenditure of this amount may be summarized as follows:

At Van Buren, $4,000 to be expended in erecting a permeable dike at a suitable point a little above the town and upon the opposite side of the river, to contract the channel and prevent it from leaving the city wharves. From Fort Gibson, Indian Territory, to the mouth of the river, the balance to be expended in the erection of permeable dikes and in rock excavation at worst places, so far as the amount of the appropriation will permit, looking toward the permanent improvement of the river, to give a channel at least 6 feet deep and 200 feet wide from Little Rock to the mouth of the river, via White River Cut-off, as provided under the act of August 5, 1886, and an all-year-round depth of water of at least 2 feet from Little Rock, Ark., to Fort Gibson, Ind. T.

Before operations were begun, at Dardanelle, a bad bar had formed along the town front, cutting off all approach to either wharf at low water or at medium stage.

From Fort Gibson to the mouth of the river, the river consists of alternating bars and caving banks, with crossings more or less troublesome at low water, a few of the latter operating to effectually close the river to navigation at extreme low water for even boats drawing but 2 feet of water. From Fort Gibson, Ind. T., to the mouth of the river, $119,630.65 has been expended, during the fiscal year ending June 30, 1892.

At Moores Rocks, 926 cubic yards of rock has been excavated, leaving 801 cubic yards yet to be excavated to complete the work.

At Big Rock stone quarry, 3 miles above Little Rock, 8,376 cubic yards of rock has been quarried and of this amount 6,754 cubic yards has been barged to Pine Bluff. At Pine Bluff, two additional dikes, Nos. 5 and 6, were built, each 150 feet long and 17 feet above low-water mark. Dikes A°, A, and No. 2 received much-needed repairs and Dikes 3 and 4 were repaired, No. 4 made a permanent rock dike, and No. 3 advanced towards completion in like manner. Early in October, 1891, the work below Mallorys Ditch, below Pine Bluff, according to project approved August 25, 1891, was commenced. This work consisted of weaving a continuous mattress 125 feet to 150 feet wide from Mallorys Ditch to a point one mile below, laid from low-water line along the bank to the bottom of the river, and securely weighted down with rock, and the bank graded to a 10-foot stage and riprapped with rock to a depth of one foot. This work was completed April 1, 1892. The riprapping, however, was carried down to within 700 feet of the end of the mattress only. Over 4,000 cubic yards of rock has been barged from Big Rock Quarry, near Little Rock, and stored on the high bank at Pine Bluff, to be used in further improvements at that point and below. During October, 1891, special surveys were made at and in the vicinity of Pine Bluff, and in December and January the same was done at Fort Smith and Little Rock. In addition to the above work, 10 barges 60 feet by 20 feet, one pile-driver barge 6 feet by 20 feet thoroughly equipped as a water pile driver and one quarter boat 90 feet by 20 feet, have been built, besides various additions made to the machinery of the plant; and the dikes above Baring Cross Bridge at Little Rock have been in part repaired.

July 1, 1891, balance unexpended	$157,100.81
Deposited to credit of Captain H. S. Taber, Corps of Engineers	.50
	157,101.31
June 30, 1892, amount expended during fiscal year	119,630.65
July 1, 1892, balance unexpended	37,470.66
July 1, 1892, outstanding liabilities	14,228.49
July 1, 1892, balance available	23,242.17
Amount appropriated by act approved July 13, 1892	250,000.00
Amount available for fiscal year ending June 30, 1893	273,242.17

Amount (estimated) required for completion of existing project.....$3,222,479.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix W 2.)

3. *Fourche Le Fevre River, Arkansas.*—The improvement of this stream was begun in 1879, under the act approved March 3, 1879. Prior to any improvement its channel was choked with snags, logs, and drift, and heavy timber overhung its banks. Several bad shoals also impeded navigation. Up to June 30, 1886, $21,000 had been expended in removing the greater part of the obstructions. By act approved August 5, 1886, $5,000 was appropriated for removing rock shoals, situated about 4 miles below Perryville. At the close of the fiscal year ending June 30, 1888, this sum had been expended, completing a channel about 500 yards long, 30 feet wide and 2 feet deep at low water through this shoal. By act approved September 19, 1890, $7,500 was appropriated. The approved project for its expenditure provides for the building and equipping of a hand-propelled snag boat at a cost not to exceed $4,000, to be operated for four months at or near extreme low water, in removing accumulated obstructions, snags, logs, drift piles, landslides, and bowlders on Piney Shoals, $450 to be expended in making a cut through May Shoal to provide for high and medium stage navigation. Up to June 30, 1891, $2,448.70 was expended in building and equipping the hand-propelled snag boat *Pioneer*. After the boat was completed, high water prevented its use during the balance of that year. During the fiscal year ending June 30, 1892, 1,923 cubic yards of rock and gravel, 1,326 snags, 4 large rack heaps, and several landslides were removed and over 25,000 overhanging trees cut and deadened, opening the river to high and medium stage navigation to Perryville Landing. The present appropriation practically meets all the present demands of commerce. Additional snagging operations and improvements upon the shoals may be required as the valley settles up and commerce increases.

July 1, 1891, balance unexpended	$5,051.30
June 30, 1892, amount expended during fiscal year	3,743.33
July 1, 1892, balance unexpended	1,307.97
July 1, 1892, outstanding liabilities	50.00
July 1, 1892, balance available	1,257.97

(See Appendix W 3.)

4. *Petit Jean River, Arkansas.*—Before improvement this river was obstructed by snags, logs, masses of driftwood, overhanging trees, and shoals. The original project for improvement contemplated rendering it navigable during high and medium stages of water, up to Danville, Ark., by cutting the overhanging trees and cutting up the snags, logs, and drift. Three thousand five hundred dollars was expended in the execution of this project to June 30, 1888. The appropriation made by act of August 11, 1888, was $2,500, and work was limited to the river below the bridge at Rocky Crossing. The new project provides for removing portions of the shoals known as Slaty Crossing and Robinsons Ridge, and certain timber from the low-water channel.

During the fiscal year ending June 30, 1890, no work was done on account of continued high water rendering it impossible to begin the work with any certainty of completing it.

The fiscal year ending June 30, 1891, was a favorable season for this work, and many obstructions to navigation were removed.

Amount appropriated by act approved July 13, 1892	$3,500

(See Appendix W 4.)

5. *White River, Arkansas.*—Before improvement the channel of this river was choked with drift piles, logs, and snags, in its lower portion and, from Batesville up, gravel bars, rocky shoals, channel bowlders, and overhanging trees, impeded navigation. The original project consisted in snagging operations, blasting ledges and bowlders, and dam building to remove gravel bars or to close chutes. The first separate appropriation for this river was made by act approved July 5, 1884. Provision for a survey of the river from Forsythe, Mo., to its mouth was added to the original project. At that date the river was in excellent navigable condition, for boats drawing not to exceed 3 feet of water, from its mouth to Newport, Ark. From Newport to Batesville there were many troublesome snags, and from Batesville to Buffalo Shoals there were numerous bad shoals, rendering navigation very uncertain. From Buffalo Shoals to Forsythe, Mo., there were many fine reaches of river, but the depth of water on Buffalo Shoals, and others, prevented any navigation at ordinary stages of water. The present plan, based on the survey, provides for the maintenance at low water of a channel 2 feet deep between Newport and Buffalo Shoals, and a channel, of not less than 5 feet deep at low water, from Newport to the mouth, and also for a limited amount of snagging operations while these improvements are in progress. The result between Newport and Buffalo Shoals is to be accomplished by the erection of solid wing dams and some rock excavation. From Newport to the mouth this result is to be accomplished by the erection of low, permeable spur dikes, to give the necessary depth of water on the shoals. Up to June 30, 1891, $93,517.24 had been expended in the work of improvement, and this completed the survey, published the maps, effectually improved the most dangerous shoals between Buffalo Shoals and Batesville, Ark., and the mouth, and completed one spur dike at Newport. During the fiscal year ending June 30, 1892, $15,190.80 was expended, continuing the above work from Batesville Cut-off to the town of Newport, Ark., a distance of 50 miles. A number of dangerous shoals over this reach were improved, the dike at Newport was repaired, and good progress made upon another dike a few miles below the town of Newport. The low state of the funds compelled suspension of work. The work has been effective and the commercial facilities increased more than any previous year of the work.

July 1, 1891, balance unexpended	$15,026.41
Received as per letter Chief of Engineers April 11, 1892	250.00
	15,276.41
June 30, 1892, amount expended during fiscal year	15,190.80
July 1, 1892, balance unexpended	85.61
Amount appropriated by act approved July 13, 1892	75,000.00
Amount available for fiscal year ending June 30, 1893	75,085.61

(See Appendix W 5.)

6. *Cache River, Arkansas.*—The first appropriation made for this reach of river became available August 11, 1888. Prior to this time the river was choked with logs, snags, and overhanging trees, and several shoals interfered with low-water navigation. The project proposes the removal of these obstructions from the town of Riverside, Ark., to the mouth of the river. Up to June 30, 1891, $7,000 had been expended carrying out the project.

No money being available for this improvement during the last fiscal year no work has been done since June 30, 1891.

Amount appropriated by act approved July 13, 1892	$2,000.00
Amount (estimated) required for completion of existing project	1,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix W 6.)

7. *Little Red River, Arkansas.*—The only improvements ever attempted upon this river were made in 1872. Prior to this work many overhanging trees and a large number of snags interfered with navigation in the lower reaches, and many bowlders obstructed flatboat and raft navigation in the reach above the present town of Judsonia. Most of the overhanging trees and snags were removed as high as Judsonia, and the bowlders remained untouched to the end of June 30, 1886.

By acts of August 5, 1886, and August 11, 1888, $8,400 was appropriated for removing the bowlders above Judsonia and dredging a channel through the shoals 3 miles below. After the work on the shoals had been nearly completed the dredge was sold, making $3,500 additional money available. Up to June 30, 1891, $9,294.25 had been expended removing the bowlders, building a dredge and barges, partial excavation of channel, cutting overhanging timber, removing a few logs and snags between Judsonia and Heber, Ark., and caring for the property. During the fiscal year ending June 30, 1892, $1,896.82 was expended on a special project, making the work between Judsonia and Heber more effective, after the work at Bess Shoals had been completed. The present appropriation will complete the project.

July 1, 1891, balance unexpended	$1,896.94
Received as per letter Chief of Engineers April 11, 1892	300.00
	2,196.94
June 30, 1892, amount expended during fiscal year	1,896.82
July 1, 1892, balance unexpended	300.12
July 1, 1892, outstanding liabilities	133.00
July 1, 1892, balance available	167.12

(See Appendix W 7.)

8. *Black River, Arkansas and Missouri.*—Before any improvements were made upon this river navigation was practically closed by snags, logs, and overhanging trees, the snags and logs in many places forming shoals, and in other places rock and gravel shoals interfered with navigation. The original plan for improvement contemplated the removal of the obstructions and the improvement of the shoals by wing dams. A few of the sloughs were to be closed up, so as to confine the water to the main channel. Up to June 30, 1891, $62,779.68 had been expended for this purpose, doing thorough work up to a few miles above the mouth of Current River and from Poplar Bluff, Mo., to Corning, Ark., and just taking up the worst obstructions to get the snag boat through the balance of the distance. Much work was left undone between Poplar Bluff, Mo., and the Arkansas State line.

During the fiscal year ending June 30, 1892, $3,181.76 was expended in operations from Corning, Ark., to the mouth of Current River, thence back to the Arkansas and Missouri State line, removing a large number of obstructions and opening the river through for the first time, so that at high and medium stages boats may reach Poplar Bluff, Mo., with reasonable facility.

July 1, 1891, balance unexpended	$3,462.72
June 30, 1892, amount expended during fiscal year	3,181.76
July 1, 1892, balance unexpended	280.96
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,280.96
Amount (estimated) required for completion of existing project annually. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	8,000.00

(See Appendix W 8.)

9. Black River, Missouri.—The first improvements attempted upon this reach of river were made in the years of 1881 and 1882. Prior to this work its channel was choked with snags and logs, and obstructed by overhanging trees, and in many places shoals interfered with its navigation at low water by any but very light-draft boats. The original plan for improvement contemplated the removal of the obstructions and the improvement of the shoals, the latter by wing dams. A few sloughs were to be closed up so as to confine the water to the main channel. Up to June 30, 1891, $16,914.21 had been expended in removing overhanging trees, trees that had fallen across the channel, dangerous snags and piles of drift, all of these items in formidable numbers, giving great relief to navigation, inadequate, however, to meet all its requirements.

During the fiscal year ending June 30, 1892, $2,990.20 was expended, furthering the same work to a limited degree, however, due to the boat's being required upon the appropriation, "improving Black River, Arkansas and Missouri," until nearly the close of the low-water season, so that less than two months' work was done before high water.

July 1, 1891, balance unexpended	$3,085.79
June 30, 1892, amount expended during fiscal year	2,990.20
July 1, 1892, balance unexpended	95.59
July 1, 1892, outstanding liabilities	75.00
July 1, 1892, balance available	20.59

(See Appendix W 9.)

10. St. Francis River, Arkansas.—Appropriations have been made for this river in connection with those for the White River. The first appropriation was made March 2, 1833, prior to which this river was choked with drift, logs, snags, and its waters spread out through a great variety of sloughs, while overhanging trees added to the difficulty of navigation. The originally adopted project was principally for snagging operations, and attempts have been made to close up some of the many sloughs. On July 5, 1884, the first separate appropriation was made. From that time to June 30, 1891, $26,499.10 had been expended in carrying out the approved project.

During the fiscal year ending June 30, 1892, $1,457.76 was expended in continuance of the work, in the execution of some badly needed work between Madison, Ark., and a point 25 miles below, exhausting the appropriation.

July 1, 1891, balance unexpended	$1,500.90
June 30, 1892, amount expended during fiscal year	1,457.76
July 1, 1892, balance unexpended	43.14
Amount appropriated by act approved July 13, 1892	8,000.00
Amount available for fiscal year ending June 30, 1893	8,043.14

Amount (estimated) required for completion of existing project annually	$8,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix W 10.)

11. St. Francis River, Missouri.—The first appropriation made for this reach of river was that of act of August 11, 1888, in amount $5,000. Prior to the work done with this sum, logs, snags, overhanging trees, and several shoals interfered with low-water navigation. The estimate, $7,300, proposed the removal of the shoals about 12 miles below Greenville and the removal of snags and other obstructions. The amount appropriated by act of August 11, 1888, was inadequate. Up to June 30, 1891, $7,642.68 had been expended in cutting a channel through the Big Drift and carrying out other provisions of the original project, combined with those of the project under the act approved September 19, 1890, which, added to the original project, provides for a hand-propelled snag boat for use between the Sunk Lands and Greenville, Mo., said snag boat being built in this period.

During the fiscal year ending June 30, 1892, $4,687.09 was expended in operations in accord with the combined projects, the removing of a formidable array of obstructions from St. Francis, Ark., to the Big Drift, a distance of about 70 miles. Work was suspended by high water and cold weather.

July 1, 1891, balance unexpended	$7,857.32
June 30, 1892, amount expended during fiscal year	4,687.09
July 1, 1892, balance unexpended	3,170.23
July 1, 1892, outstanding liabilities	193.35
July 1, 1892, balance available	2,976.88

(See Appendix W 11.)

12. Little River, Missouri.—Before improvement this river was obstructed by snags, logs, masses of driftwood, and shoals, and was divided into two chutes. The project for improvement contemplates prolonging medium-stage navigation by closing one of the chutes and removing the obstructions enumerated from the other.

The first appropriation ever made for this river was $5,000, act of August 11, 1888; $3,000 additional followed in the act of September 19, 1890. Up to June 30, 1891, $4,968.10 had been expended, carrying the work to within 20 miles of the lake, and building a dam 300 feet long across the right chute.

During the fiscal year ending June 30, 1892, $3,011.38 was expended, removing snags, overhanging trees and drift piles over the portion not worked last season.

July 1, 1891, balance unexpended	$3,031.90
June 30, 1892, amount expended during fiscal year	3,011.38
July 1, 1892, balance unexpended	20.52

(See Appendix W 12.)

EXAMINATION AND SURVEY, MADE IN COMPLIANCE WITH PROVISIONS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination at *Clarendon and the lower White River, Arkansas, to determine the effect of backwater from the Mississippi River and its cause and the means and cost of preventing injury therefrom*, was made by the local engineer in charge, Capt.

Taber, and report thereon submitted through Col. C. B. Comstock, Corps of Engineers, Division Engineer, Southwest Division. It is the opinion of Capt. Taber, and of the division engineer, based upon the facts and reasons given, that this locality is worthy of improvement. This opinion being concurred in by me, Capt. Taber was charged with and completed its survey and submitted report thereon, through the division engineer. Col. Comstock stated that the construction of levees along the Mississippi River below Helena, Ark., will prevent, as far as is practicable, injurious effects of the Mississippi River backwater on the White River. The reports were transmitted to Congress and printed as House Ex. Doc. No. 118, Fifty-second Congress, first session.

Further information in regard to this matter being called for by resolution of the House of Representatives of March 4, 1892, a supplemental report by Col. Comstock, presenting an approximate estimate of $1,100,000 as cost of constructing sufficient levees along the Mississippi River from Helena to the White River, was, with the reports of the examination and survey, transmitted to Congress and printed as House Ex. Doc. No. 163, Fifty-second Congress, first session. (See also Appendix W 13.)

REMOVING SNAGS AND WRECKS FROM MISSISSIPPI RIVER; IMPROVEMENT OF MISSISSIPPI RIVER BETWEEN OHIO AND ILLINOIS RIVERS, OF HARBOR AT SAINT LOUIS, AND OF OSAGE AND GASCONADE RIVERS, MISSOURI, AND OF KASKASKIA RIVER, ILLINOIS.

Officer in charge, Maj. A. M. Miller, Corps of Engineers; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Removing snags and wrecks from Mississippi River.*—Before this work was inaugurated the navigation of the river was very much interfered with by numerous snags, logs, etc., which had lodged in the channel, and to which a new accession was brought down on each rise of the river, thus constantly adding new and unknown obstructions to those already there. A large number of wrecks also occupied the channel and were very dangerous to the safety of passing boats.

For the removal of these obstructions appropriations were made as early as 1824, and the project adopted consisted in building boats suitable for removing the snags, etc., and operating them whenever the stage of water was favorable for the work and funds were available.

The total amount expended for this purpose can not be definitely given, as previous to the appropriation made by act of March 3, 1879, a general amount was appropriated to be applied to several streams as their needs required. From March 3, 1879, when the first specific appropriation was made, up to June 30, 1891, $810,760.77 was expended for this purpose. The navigation of the river has been very materially improved by this method and the danger to boats lessened.

During the fiscal year ending June 30, 1892, $98,250 was expended. Two snag boats were employed between the mouth of the Missouri River and Natchez, Miss., removing obstructions. The boats worked for a total of 14 months, removing 3,389 snags, cutting down 20,571 trees, removing 30 drift piles, and traveling a distance of 13,043 miles. This work greatly benefited navigation and commerce.

The boats were thoroughly overhauled and repaired and placed in good working order. The new boilers ordered for the *Macomb* during the previous fiscal year were received and placed on the boat; a new butting-beam was also placed on this boat.

An annual appropriation has been made for carrying on this work.

Amount drawn under section 7, act of August 11, 1888	$98,250
June 30, 1892, amount expended during fiscal year	98,250
July 1, 1892, amount available for fiscal year ending June 30, 1893	100,000

(See Appendix X 1.)

2. Mississippi River between the Ohio and Illinois rivers.—The original condition of the navigable channel of this portion of the Mississippi River, before the work of improvement was begun, was such that the natural depth at low water was in many places from 3½ to 4 feet, and the water was scattered by islands, which formed sloughs behind them, thus wasting the water available for low-water navigation.

The project adopted for improvement consists in closing these sloughs, and, by contraction works, the concentration of the water between banks 2,500 feet apart, the object being thereby to obtain a depth of 8 feet in the channel between St. Louis and Cairo, and 6 feet between Grafton and St. Louis at standard low water, or at a stage corresponding to a reading of 4 feet on the St. Louis gauge.

The amount expended up to the close of the fiscal year ending June 30, 1891, was $4,129,014.16 and the condition of the improvement at that time was such that but little trouble was experienced between St. Louis and Lucas Crossing, a distance of 30 miles, as far as the work of improvement had been carried on June 30, 1891, and then only at extreme low water. For stages of water above 4 feet on the St. Louis gauge there was generally a depth of at least 6 feet in the channel.

The amount expended during the fiscal year ending June 30, 1892, was $276,168.99, and was applied to repairing plant, and carrying on works at the following localities:

Alton.—This work consisted in building an extension of 2,400 feet to the stone dike erected in 1882 and 1884, also in raising the crest of old dike 3 feet for a distance of 800 feet at its lower end. The object of the work was to prevent the further formation of a bar in front of the Alton landing and to wash away what had already formed. The work was commenced on August 10, 1891, and completed May 3, 1892. The effect of this work can not be determined until the next low-water season, as during the time of construction and since then, the Missouri River was higher than the Mississippi River, and in consequence backwater from the former so deadened the current that the work had but little effect on the deposit in the harbor. At least one high water from the Mississippi, when the Missouri is at a lower stage, is required before any material change can be expected. The amount expended on this work during the fiscal year was $49,948.78.

Rush Tower.—Work at this locality consisted in an extension of the general plan of improvement, so as to include this section of the river. Work was commenced just prior to the close of the previous fiscal year and was continued during the present one. A series of four hurdles, of an aggregate length of 5,920 feet, was built on the east side of the river at James Landing; another series of three hurdles, having an aggregate length of 3,790 feet, was built on the west side near Wilcox Landing, and the bank at Calico Island was protected for a distance of 4,000 feet.

The object of this work was to concentrate the water into one channel at low water, it being scattered through three or four. At the close of the fiscal year a high stage of water still prevailed, and the full effect of the work will not be apparent until next low-water season. The amount expended at this locality during the fiscal year was $181,066.

Ste. Genevieve.—The project for the improvement of the river at this point had for its object the retention of the channel at Little Rock, the landing for Ste. Genevieve. To do this a series of three hurdles was built on the opposite side of the river, and they have been successful in obtaining the desired results. Work was in progress on these hurdles at the close of the last fiscal year and they were completed July 17. To induce a further fill, the wattling on the hurdles was raised to the 20-foot stage during the month of March. The amount expended during the fiscal year was $31,422.71.

Surveys.—A resurvey of the river, from the head of Carrolls Island to the foot of the Rush Tower work and at Ste. Genevieve, was made for the purpose of determining changes in the banks and channel of the river.

The original estimated cost of this work, as revised in 1883, was $16,997,100, of which amount $4,529,600 has been appropriated.

July 1, 1891, balance unexpended	$400,365.84
June 30, 1892, amount expended during fiscal year	276,168.99
July 1, 1892, balance unexpended	124,196.85
July 1, 1892, outstanding liabilities	3,827.58
July 1, 1892, balance available	120,369.27
Amount appropriated by act approved July 13, 1892 *	525,000.00
Amount available for fiscal year ending June 30, 1893	645,369.27
Amount (estimated) required for completion of existing project	11,942,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1894 †	758,333.33
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix X 2.)

3. *Harbor at St. Louis, Missouri.*—The St. Louis Harbor may be divided into two parts, the upper and the lower, the line of division being the Eads Bridge. The upper portion, included between the bridge and the northern limits of the city, is about 10 miles in length, of which the only part to be considered as at present included in the practical harbor is the reach between the Eads Bridge and the Merchants Bridge, 3 miles in extent. This reach was obstructed by middle bars and by shoals near the Illinois shore, which interfered with landings on that side and rendered navigation difficult. The lower portion, included between the bridge and River des Peres, is 8 miles long, and the channel is good at all stages of water, the landings being easily accessible at all points.

The project adopted for the improvement of the harbor consisted in contracting the width of the river between the Merchants and Eads bridges to an average width of about 2,000 feet by constructing a series of hurdles extending out from the Illinois shore, which would cause a new bank to be built up between them.

The amount expended in building these hurdles, up to the close of the fiscal year ending June 30, 1891, was $109,303.77, and at that time the effect of the work was quite appreciable, a considerable fill having taken place between the hurdles.

During the fiscal year ending June 30, 1892, $41,226.44 was expended in building hurdle No. 5 of this system, which had previously been omitted on account of a ferry landing; in the extension of No. 8 to the river line; in the repair of Nos. 6 and 7; in wattling Nos. 2 to 11, and in the sinking drift above the hurdles.

---

* This appropriation was made for improving Mississippi River between mouths of the Ohio and Missouri rivers.

† For continuing work between mouths of the Ohio and Missouri rivers.

The effect of this work, as far as obtaining increased depths in the channel, can not be determined until the low-water season of next fall. Soundings have shown that a large fill has taken place between the hurdles and it is confidently expected that the work will do all that is required, especially after the unusual and prolonged high-water season of this spring.

The full amount of the estimate has been appropriated for this work. With the balance remaining on hand it is proposed to repair the damage caused to hurdles by ice and drift and extend them wherever found necessary.

July 1, 1891, balance unexpended	$72, 696. 23
June 30, 1892, amount expended during fiscal year	41, 226. 44
July 1, 1892, balance unexpended	31, 469. 79
July 1, 1892, outstanding liabilities	230. 04
July 1, 1892, balance available	31, 239. 75

(See Appendix X 3.)

4. *Gasconade River, Missouri.*—The navigation on this river was seriously interfered with by snags, logs, and leaning timber, and at times almost suspended by reason of shoal crossings. Its improvement was commenced in 1880 and the project adopted consisted in the removal of snags and logs from the bed of the river, in the cutting of leaning timber from the banks, and in the construction of wing dams and training walls at the shoals, to concentrate the water and thereby increase the depth.

The amount expended to June 30, 1891, was $42,615.96, and resulted in improved facilities for navigation as well as in a prolongation of the boating season.

During the fiscal year ending June 30, 1892, $2,073.55 was expended in repairing and raising dam at Pryor's Mill, which resulted in an increased flow of water around the left chute at that point and an increase in depth of 4 inches. The following obstructions were also removed from the bed and banks of the river between Arlington and the foot of Pryors Bend, thereby affording better facilities for navigation: 419 snags, logs, etc.; 8 rack heaps; 1 bowlder, and 2,153 trees.

July 1, 1891, balance unexpended	$3, 884. 04
June 30, 1892, amount expended during fiscal year	2, 073. 55
July 1, 1892, balance unexpended	1, 810. 49
July 1, 1892, outstanding liabilities	62. 12
July 1, 1892, balance available	1, 748. 37
Amount appropriated by act approved July 13, 1892	4, 000. 00
Amount available for fiscal year ending June 30, 1893	5, 748. 37

(See Appendix X 4.)

5. *Osage River, Missouri.*—Before any improvements were made the navigation on this river was rendered difficult by reason of numerous snags and other obstructions, and at times suspended, owing to insufficient depth of water over shoal crossings.

The first improvement of this river was undertaken by the State of Missouri, about thirty to thirty-five years ago, and consisted in an attempt to concentrate the water in a narrow channel over the shoals by means of wing dams built out from one or both banks, and thus deepen it.

The General Government assumed charge of the improvement in 1871, and the first efforts were expended in an attempt to deepen the water over the shoals by dredging; after this the method pursued consisted in training walls so as to regulate the width of water way suitable to the low-water discharge of the river. This method is still pursued. Snags and other obstructions found in the channel were also removed and leaning timber was cut from the banks. The construction of a lock and dam near the mouth of the river was also authorized by the river and harbor act of September 19, 1890.

The amount expended to June 30, 1891, was $205,929.47, the result of which was that the navigation was materially improved, the channel having been cleared of the worst obstructions and the water deepened at several of the shoalest crossings.

During the fiscal year ending June 30, 1892, $5,772.25 was expended in preparing plans for lock and dam, in gauging the river, in repairing plant, and in the removal of 66 snags, 342 trees, 42 drift piles from the bed and banks of the river. This latter work has cleared the river of obstructions from the mouth to a point 80 miles above, and it is now in good navigable condition for most of the year. New obstructions may be expected from time to time, with each rise and fall in the river, and will require removal.

July 1, 1891, balance unexpended	$54,070.53
June 30, 1892, amount expended during fiscal year	5,772.25
July 1, 1892, balance unexpended	48,298.28
July 1, 1892, outstanding liabilities	481.13
July 1, 1892, balance available	47,817.15
Amount appropriated by act approved July 13, 1892	50,000.00
Amount available for fiscal year ending June 30, 1893	97,817.15
Amount (estimated) required for completion of lock and dam	110,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix X 5.)

6. *Kaskaskia River, Illinois.*—The original condition of this river was such that navigation at low water was almost, if not entirely, suspended by reason of snags, shoals, and bars, and depended to a great extent on the stage of water in the Mississippi River as to its duration. The least depth found, when the St. Louis gauge read 6.5 feet, was 9 inches, over what is called the "Nine-mile Shoal," 6 miles above its mouth, which virtually "blocked" the river at low water. At high water navigation was possible as far up as New Athens.

The first appropriation for improving the river was made in 1890, and the project adopted for its improvement consisted in excavating a channel through the shoals of such a depth as would insure a low-water navigation of 36 inches, and in the removal of snags and obstructions from the channel.

No money was expended on this work up to close of the fiscal year ending June 30, 1891, the river not having been at a suitable stage since the appropriation was made to warrant starting work, consequently no change had occurred in the conditions of the river at that date.

During the fiscal year ending June 30, 1892, $5,760.48 was expended in blasting a channel 75 feet in width in the clear, and of an average depth of 36 inches at low water, through the "Nine-Mile Shoal," also a channel through the "Evansville Shoal" 60 feet wide and 34 inches deep at low water, and in removing the snags found in the channel of the river between those shoals. The result of this work was to enable boats to enter the river at lower stages of water than formerly and also to prolong the low-water boating season as far up as Evansville.

July 1, 1891, balance unexpended	$6,000.00
June 30, 1892, amount expended during fiscal year	5,760.48
July 1, 1892, balance unexpended	239.52
Amount appropriated by act approved July 13, 1892	4,500.00
Amount available for fiscal year ending June 30, 1893	4,739.52

(See Appendix X 6.)

IMPROVEMENT OF MISSISSIPPI RIVER BETWEEN MOUTH OF ILLINOIS RIVER AND MINNEAPOLIS, AND OPERATING AND CARE OF DES MOINES RAPIDS CANAL AND DRY DOCK.

Officer in charge, Maj. A. Mackenzie, Corps of Engineers; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. Operating snag boats and dredge boats on Upper Mississippi River.—At the beginning of the fiscal year there was available, under act of August 11, 1888, the sum of $25,000.

From July 1 to October 31, 1891, and from May 12 to 31, 1892, the snag boat *General Barnard* was employed removing snags and other obstructions and assisting interests of navigation between Minneapolis and the mouth of the Missouri River.

The snag boat *J. G. Parke*, dredge *Phœnix*, launch *Elsie*, and a number of dump boats were employed as a dredging and wrecking plant from July 1 to October 31, 1891, between St. Paul and Keokuk.

The total amount expended for snag-boat service on the Upper Mississippi River between Minneapolis and the mouth of the Missouri River to June 30, 1891, is $599,640.

By the river and harbor act of August 11, 1888, provision was made for operating snag boats and dredge boats on the Upper Mississippi River under a permanent appropriation, the sum so expended not to exceed the amount appropriated in said act for such purpose. The clause of the act regulating the annual expenditure for snag boats and dredge boats on the Upper Mississippi River is as follows:

> For operating snag boats and dredge boats on Upper Mississippi River, twenty-five thousand dollars.

The total amount of freight transported on the Upper Mississippi River during the calendar year 1891 was, approximately, 4,200,000 tons.

June 30, 1892, amount drawn from Treasury under permanent appropriation	$25,000.00
June 30, 1892, amount expended during fiscal year	25,000.00
July 1, 1892, amount available under permanent appropriation of August 11, 1888, for fiscal year ending June 30, 1893	25,000.00

(See Appendix Y 1.)

2. Mississippi River between Des Moines Rapids and mouth of Illinois River.—Operations in this district were in charge of Maj. E. H. Ruffner, Corps of Engineers, to January 16, 1892, when charge of this district was transferred to Maj. A. Mackenzie, Corps of Engineers.

Maj. Mackenzie presents a report, compiled from office records, on the work of the first half of the fiscal year. In 1892 very little work has been done, on account of high water.

Under this appropriation the improvement of through navigation is chiefly carried on, although allotments have from time to time been made for special work. Work has been in progress under approved projects since 1878, and very favorable results have been secured, showing that with a continuance of the work under liberal appropriations, the low-water channel of the Mississippi River between Des Moines Rapids and mouth of Illinois River can be made easily navigable at all stages for the class of boats using the river.

The interests for which the improvement is being made are very large and important. The general project for the improvement proposes the contraction of the channel or water way by means of wing dams and dams closing side chutes to such an extent as, by means of the scour thereby caused, to afford a channel of sufficient width and of a depth of 4.5 feet at low water to be eventually increased to 6 feet. There was expended under this head of appropriation to June 30, 1891, the sum of $1,208,594.91.

During the past year work has been carried on by days' labor and use of Government plant in vicinity of Clarksville at Cottonwood Island Reach, at foot of Hickory Chute, above Hannibal, and between Canton and Lagrange, and by contract in Quincy Bay.

The river and harbor act approved July 13, 1892, appropriated $600,000 for improving Mississippi River between mouth of Missouri River and Minneapolis, and authorized the Secretary of War to carry on the work continuously by entering into additional contracts, or otherwise, to be paid for as appropriations may be made therefor.

July 1, 1891, balance unexpended		$121,340.91
June 30, 1892, miscellaneous receipts		64.20
		121,405.11
June 30, 1892, amount expended during fiscal year		60,541.35
July 1, 1892, balance unexpended		60,863.76
July 1, 1892, outstanding liabilities	$153.82	
July 1, 1892, amount covered by uncompleted contracts	28,783.72	
		28,937.54
July 1, 1892, balance available		31,926.22

(See Appendix Y 2.)

3. *Des Moines Rapids, Mississippi River.*—This work was commenced in 1867. The adopted plan provided for the building of a closed canal 8 miles long and for cutting an open channel in the rock bed of the river over the remaining 4 miles of rapids. The canal was opened in August, 1877, though not fully completed, and has been in operation since that time.

During the past year the work of protecting the outside slope of the canal embankment was continued and the raising of the middle lock walls was completed. The work remaining to be done under approved project is the removal of a small amount of rock above grade, the completion of the sluice at Prices Creek, and the completion of the protection of canal embankment.

There has been appropriated and allotted for this work the sum of $4,574,950. The net cost to the United States has been, to June 30, 1891, $4,550,130.83.

July 1, 1891, balance unexpended	$10,230.99
June 30, 1892, amount expended during fiscal year	4,388.56
July 1, 1892, balance unexpended	5,842.43

(See Appendix Y 3.)

4. *Operating and care of Des Moines Rapids Canal and Dry Dock.*—During the past year the Des Moines Rapids Canal was opened for navigation 234 days, during which time there passed through it 577 steamboats and 191 barges, carrying 10,260 passengers, 12,228 tons of merchandise, and 63,210 bushels of grain. There also passed through 140,654,084 feet, B. M., of lumber, 24,514,000 feet of logs, 61,141,137 shingles, and 39,476,926 lath. The expenses of the year have been $51,550.17 and the estimates for the coming year amount to $72,581.25.

The cost of operating and care of the canal is provided for by an indefinite appropriation made by act of March 3, 1881.

July 1, 1891, balance on hand	$1.80
June 30, 1892, amount drawn from Treasury under indefinite appropriation	44,000.00
	44,001.80
June 30, 1892, amount expended during fiscal year	43,968.92
June 30, 1892, balance on hand	32.88
July 1, 1892, outstanding liabilities	7,581.25

(See Appendix Y 4.)

5. *Mississippi River between Minneapolis and Des Moines Rapids.*—Prior to August 11, 1888, this work was carried on under appropriations for "improving Mississippi River from St. Paul to Des Moines Rapids." The act of August 11, 1888, extended the upper limits of the district from St. Paul to Washington Avenue Bridge, Minneapolis.

Under this appropriation is carried on the improvement of through navigation. Work has been in progress under approved projects since 1878, and very favorable results have been secured, showing that with a continuance of the work under liberal appropriations, the low-water channel of the Mississippi River between St. Paul and the Des Moines Rapids can be made comparatively safe, convenient, and permanent. The interests for which the improvement is being made are very large and important. The amount of freight carried during 1891, including the logs and lumber floated in the river, aggregated, approximately, 4,200,000 tons.

The original condition of the channel between the Des Moines Rapids and St. Paul was such that in low stages the larger boats were unable to proceed farther up the river than La Crosse or Winona; and, in many seasons, at points much farther down, their progress was checked or seriously interfered with. In all such cases through freight was reshipped on small and light-draft boats or barges. The originally adopted project for the improvement, which has not been materially changed, proposed the contraction of the channel or water way by means of wing and closing dams to such an extent as, by means of the scour thereby caused, to afford a channel of sufficient width, and of a depth of 4.5 feet at low water, to be eventually increased to 6 feet. There was expended on the permanent improvement of through navigation to June 30, 1891, the sum of $2,203,632.11, or $4,279 per mile. At that date, and for several years previous, the condition of the channel was such as to permit the passage of the largest boats at the lowest stages through to St. Paul.

Between Minneapolis and St. Paul (Omaha Bridge), there was expended to June 30, 1891, the sum of $6,147.99, or $559 per mile.

During the past year work has been carried on by days' labor and use of Government plant between Minneapolis and St. Paul, between St. Paul and Prescott, between Prescott and Lake Pepin, between Minneiska and La Crosse, in vicinity of La Crosse, Crooked Slough, and Clinton, at Rock Island Rapids and Montrose Harbor, and between Keithsburg and Montrose; by contract, between Reads and Minneiska, at Prairie du Chien, and between Bellevue and Savanna; and, by informal agreement, between Minneapolis and St. Paul, between St. Paul and Prescott, in Cassville Slough, and at Port Byron Harbor. At several localities temporary and permanent channels were deepened by dredging. The work of the year has resulted in increased width and depth of channel at all the points mentioned.

July 1, 1891, balance unexpended		$411,390.86
June 30, 1892, amount expended during fiscal year		274,936.79
July 1, 1892, balance unexpended		136,454.07
July 1, 1892, outstanding liabilities	$302.72	
July 1, 1892, amount covered by uncompleted contracts	14,956.76	
		15,259.48
July 1, 1892, balance available		121,194.59
Amount appropriated by act approved July 13, 1892*		600,000.00
Amount available for fiscal year ending June 30, 1893		721,194.59
Amount that can be profitably expended in fiscal year ending June 30, 1894†		866,666.67
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix Y 5.)

IMPROVEMENT OF MISSISSIPPI RIVER ABOVE FALLS OF ST. ANTHONY, MINNESOTA; OF CHIPPEWA RIVER, WISCONSIN; OF ST. CROIX RIVER, WISCONSIN AND MINNESOTA; OF MINNESOTA RIVER, MINNESOTA, AND OF RED RIVER OF THE NORTH, MINNESOTA AND NORTH DAKOTA; GAUGING MISSISSIPPI RIVER AT OR NEAR ST. PAUL, MINNESOTA.

Officer in charge, Maj. W. A. Jones, Corps of Engineers, with Lieut. Hiram M. Chittenden, Corps of Engineers, under his immediate orders; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Mississippi River above Falls of St. Anthony, Minnesota.*—The present project, adopted in 1880, consists in the improvement of the river between Aitkin and Grand Rapids, a distance of 130⅛ miles, by removal of snags, bowlders, bars, and leaning trees from the channels and construction of wing dams where necessary to afford 3 feet depth at low-water stage, the cost being estimated at $54,127. In 1889 the estimate was increased to $63,000. Under the appropriations of 1880, 1881, and 1882, the river between the points named was well cleared of large numbers of obstructions. But between 1884 and 1888, and during the flood of the latter year, large numbers of snags and overhanging trees were formed.

The appropriation of $10,000 made by act of August 11, 1888, was applied to removal of obstructions between Grand Rapids and a point about half way to Aitkin, and in addition a number of bowlders were removed to within 20 miles of the latter point.

Before improvement commenced in 1880, the stream between Aitkin and Grand Rapids was so obstructed that navigation was difficult and at times almost impossible for steamers of lightest draft.

---

* This appropriation was made for improving Mississippi River between Minneapolis and mouth of Missouri River.

† For continuing work between Minneapolis and mouth of Missouri River.

Total expended under present project to June 30, 1891, including outstanding liabilities, $55,439.35.

There was then a general depth in the improved channels of 3 feet at low water. A few snags and leaning trees offered some obstruction, but did not seriously interfere with navigation.

During July, August, and September, 1891, work was carried on in removing snags and leaning trees between Grand Rapids and Aitken.

For a number of years previous to the present season several steamers have navigated this portion of the Mississippi, carrying passengers and freight to the settlements and supplies for lumber camps.

The opening, during the winter of 1889-'90, of the Duluth and Winnipeg Railroad, from Duluth to the Mississippi River, resulted in one steamer being withdrawn from the freight and passenger business, though at the beginning of the season of 1891 she was again put into commission.

July 1, 1891, balance unexpended	$7,592.27
June 30, 1892, amount expended during fiscal year	5,749.21
July 1, 1892, balance unexpended	1,843,06
July 1, 1892, outstanding liabilities	20.92
July 1, 1892, balance available	1,822.14

(See Appendix Z 1.)

2. *Reservoirs at headwaters of Mississippi River.*—The object of the reservoirs is to collect surplus water, principally from the precipitation of winter, spring, and early summer, to be systematically released so as to benefit navigation upon the Mississippi River below the dams. The reservoir project is the outcome of surveys and examinations made in 1869, 1874, 1878, and 1879. From the results of these examinations and further examinations made in 1880 the first cost of constructing reservoir dams in Minnesota and Wisconsin was placed at $1,809,083. The cost of land and other damages to result from construction and operation of the proposed dams was not included in that estimate, as they could not be predicted with any approach to accuracy.

The present project consists in constructing reservoir dams at the head waters of the Mississippi River in Minnesota, that locality having been selected for commencing the work, in consequence of an appropriation made by the river and harbor act approved June 14, 1880, for construction of a reservoir dam at Lake Winnibigoshish, Minnesota, and for other reasons, given in Appendix Y to the Annual Report for 1886. By 1886 four of the reservoirs had been created. During May and June, 1891, men and materials were assembled for the construction of a fifth reservoir at Sandy Lake.

Total expended on this work to the close of the fiscal year ending June 30, 1891, including examinations at proposed dam sites, land damages, amounts paid to commissioners in attempted settlement of awards to Indians, and care and maintenance of the works, $619,850.20.

During the past year the operations have been: Operating completed reservoir, continuing construction of Sandy Lake Dam, and acquiring title to lands, by condemnation proceedings, that will be subject to overflow by the Sandy Lake Dam.

The reservoirs were operated 1885-'91, during the seasons of low water, to the benefit of navigation on more than 165 miles of the Mississippi River, viz, between Grand Rapids and Aitkin, 130½ miles, and from St. Paul to some distance below the confluence of the Mississippi and St. Croix rivers.

The officer in charge recommends appropriations for the operation and maintenance of the five reservoirs and for hydrological and meteorological observations, to determine the effect of the reservoir water. The latter purpose is specially worthy of consideration, for the result of the observations extending over a period of several years would determine the true effectiveness of the reservoirs.

July 1, 1891, balance unexpended	*$95, 690. 28
June 30, 1892, amount expended during fiscal year	55, 908. 67
July 1, 1892, balance unexpended	39, 781. 61
July 1, 1892, outstanding liabilities	9, 323. 84
July 1, 1892, balance available	30, 457. 77
Amount appropriated by act approved July 13, 1892	60, 000. 00
Amount available for fiscal year ending June 30, 1893	90, 457. 77
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	1, 034, 683. 50

(See Appendix Z 2.)

3. *Chippewa River, including Yellow Banks, Wisconsin.*—The plan for improvement of the Chippewa River consists in revetment of caving bends and construction of dams and jetties from Eau Claire to the confluence of the Chippewa and Mississippi, a distance of 57 miles, to confine the low-water volume to a channel of nearly uniform width and depth. The general plan was adopted in 1877, and the work has been carried on in accordance with it, varying, however, more or less as to location and extent of dams, jetties, etc. The protection of the Yellow Banks consists in a revetment of piling and fascines, the latter to be crowned with rock. The object of the Yellow Banks protection is to prevent their erosion, and thus to relieve the channels of the Chippewa River and of the Mississippi below the junction of the two streams from the masses of sand contributed by those banks. The plan for protecting the banks was adopted in 1883. The improvement of the river and the protection of the Yellow Banks were regarded as separate and distinct works until the act of August 11, 1888. Estimated cost of the consolidated improvement, including all the expenses from the commencement, $272,487.72.

Before the improvement commenced the depth on the bars at low water seldom exceeded 18 inches, and the crossing at the mouth of river was extremely difficult at that stage, owing to the volume of the river joining the Mississippi through a number of channels of insufficient depth. These latter-named channels were contracted into one of good depth by means of long parallel jetties. Generally, wherever works for improvement were constructed by the Government, the low-water depths were increased from 18 inches to 3 to 4 feet, and the general improvement not only greatly facilitated the passage of steamers and rafts, but also greatly reduced the expense of rafting manufactured lumber.

Localities remaining to be improved have a least depth in the channel of about 2 feet.

No work, except slight repair, has been done at the Yellow Banks since 1883, when 4,978 linear feet of bank revetment had been completed and the piling for 3,275 feet had been driven ready for the backing of brush and stone.

---

*In Annual Report, 1891, amount unexpended July 1891, was stated as $80,027.11. In February, 1892, the amount of $15,663.17 was transferred back to the appropriation from amounts set aside in 1882 for payment of awards to Indians.

Total expended from commencement of operations in 1877 to June 30, 1891, including outstanding liabilities, $157,407.66.

During the past fiscal year there has been constructed a sheer boom at Dead Lake Cut-off; a dam of brush and stone, 1,000 feet in length, and 500 feet of foundation (3 courses) for another dam, at Plum Island Flats.

July 1, 1891, balance unexpended	$9,435.87
June 30, 1892, amount expended during fiscal year	7,721.89
July 1, 1892, balance unexpended	1,713.98
July 1, 1892, outstanding liabilities	538.76
July 1, 1892, balance available	1,175.22
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	6,175.22
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	100,737.72

(See Appendix Z 3.)

4. *St. Croix River, Wisconsin and Minnesota.*—The original project for improvement, adopted in 1878, was based upon a survey made in 1874, when the river was at a high stage of water and but comparatively few obstructions to be seen. It contemplated removal of snags, bowlders, sand bars, etc., and contraction of the low-water channels from Taylor Falls to the confluence of the river with the Mississippi into one of nearly uniform width. Estimated cost, $21,758. At low water, however, the channel had in many places but 2 feet depth, and steamers and barges made their way as best they could amongst the obstructions; at times it was impossible for them to get over the shoal places. The present project, adopted in 1880, and modified as to cost in 1882, and again in 1889, is based upon a low-water survey made in 1879, and differs from that originally adopted only in amount of work to be done. Estimated cost, $108,700.

Expended under present project to June 30, 1891, including outstanding liabilities, $80,717.94.

Total expended under original and present projects to June 30, 1891, including outstanding liabilities, $98,717.94.

The effect of the work of improvement has been to secure a least depth of 3 feet on the improved bars above Stillwater and 4 to 5 feet on the bars below that place. Generally it may be said of this improvement that at many points navigation has been rendered permanent where formerly it was uncertain, and that in other places it has been made practicable where before improvement it was impossible.

In the improved parts of the river above Stillwater there is a low-water depth in the channel of 2 feet; below Stillwater there is a good channel with a least depth of 4 feet.

The work of improvement during the last year has consisted in widening the channel over the Hudson Bar by dredging, in removing snags and sunken logs, and making minor repairs to Log House Dam. The work at Hudson enabled the raft boats, with their large tows, to more easily make the run over the bar.

Expended during the fiscal year ending June 30, 1891, including outstanding liabilities, $1,743.08.

July 1, 1891, balance unexpended	$4,796.99
June 30, 1892, amount expended during fiscal year	4,747.55
July 1, 1892, balance unexpended	49.44
July 1, 1892, outstanding liabilities	10.46
July 1, 1892, balance available	38.98
Amount appropriated by act approved July 13, 1892	8,000.00
Amount available for fiscal year ending June 30, 1893	8,038.98
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	18,200.00

(See Appendix Z 4.)

5. *Minnesota River, Minnesota.*—From 1867 to 1873 Congress appropriated $77,500 for improving the Minnesota River. The appropriations were applied to removing snags and bowlders, so as to afford a least depth at low-water stage of 2 to 3 feet. In 1874 a survey was made from the mouth of the river to South Bend, a distance of about 116 miles, to determine the practicability of improving the navigation by means of canals, locks, and dams. Based upon this survey, estimates were made for five locks and dams and removal of snags, etc., at a cost of $733,868.63, the cost of removing snags, etc., being therein placed at $34,585.10, including contingencies. Following this report, Congress made three appropriations, of $10,000 each by acts approved March 3, 1875, August 14, 1876, and June 18, 1878, which sums were applied to clearing the river of obstructions below South Bend.

Expended to June 30, 1879, $117,457.

Since 1879 no work for the improvement of the river has been undertaken. Under the appropriations above named the removal of obstructions cleared the way over long stretches of the river between Minnesota Falls and a point about 30 miles below Henderson (16.7 miles above Shakopee). Little or no use was made of the cleared channels, as there was not sufficient water in the channel to permit navigation during the low-water periods. The rapidly caving banks on the upper section of this stream cause snags and leaning trees to form, so that channels that were cleared of them 12 years ago are more or less encumbered with them to-day.

No expenditures have been made for the improvement of the lower part of the river, which affords much better facilities for river traffic than the upper part.

From Shakopee to the Mississippi the river is deep except on two bars. There are few snags on this reach.

The river and harbor act of August 11, 1888, appropriated $10,000 for improving the Minnesota River, including protection of the banks opposite the borough of Belle Plaine. It appearing from an examination made in September, 1888, that the sum was inadequate for the purposes named, its expenditure for work of improvement was deferred until the further wishes of Congress in the matter might be known.

Total expended on the improvement of the whole river to the close of the fiscal year ending June 30, 1891, $117,532.

July 1, 1891, balance unexpended	$9,967.00
July 1, 1892, balance unexpended	9,967.00
July 1, 1892, outstanding liabilities	9.79
July 1, 1892, balance available	9,957.21

Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	$693,868.63

(See Appendix Z 5.)

6. *Red River of the North, Minnesota and North Dakota.*—The project for the improvement of this river from Breckenridge to the northern boundary line, adopted in 1877 and amended as to cost in 1883, consists in the removal of snags, leaning trees, and bowlders, and in dredging channels through the bars, at an estimated cost of $179,310. A revised estimate made, in 1887, placed the cost of completing the improvement at $79,598.37.

Before improvement the ruling depth upon bars between Moorhead and Goose Rapids at ordinary low water was but 1½ feet and below Grand Forks 2 feet, while between Moorhead and Abercrombie the navigation was at all times difficult.

The work to June 30, 1891, has resulted in opening a channel 3 feet deep at ordinary low water and 60 feet wide from Moorhead to a point 80 miles north, and a channel 4 feet deep at ordinary low water and about 70 feet wide from Grand Forks to a point 62 miles north by river; also in the removal of snags and trees between Moorhead and Abercrombie so as to afford safe passage for steamers between those points during high and medium stages of water.

Total amount expended, including outstanding liabilities, to June 30, 1891, $198,932.58.

Dredging operations in 1891 were continued to October 28 on the reach of river north of Grand Forks, and resulted in extending the dredged channels 22½ miles. The excavated channels are 4 feet in depth at low water and aggregate 21,510 feet in length; 100,442 cubic yards of material was removed.

July 1, 1891, balance unexpended	$19,158.83
June 30, 1892, amount expended during fiscal year	17,091.78
July 1, 1892, balance unexpended	2,067.05
July 1, 1892, outstanding liabilities	1,300.00
July 1, 1892, balance available	767.05
Amount appropriated by act approved July 13, 1892	25,000.00
Amount available for fiscal year ending June 30, 1893	25,767.05
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	9,598.37

(See Appendix Z 6.)

7. *Gauging Mississippi River at or near St. Paul, Minnesota.*—The Board of Engineers, to whom was referred the project for the application of $37,500 appropriated by the river and harbor act of August 5, 1886, for reservoirs at headwaters of Mississippi River, recommended in their report dated May 24, 1887, "that such gaugings be made at or near St. Paul during the annual operation of the reservoirs as shall determine accurately the discharge at that point at critical periods." (Page 1692, Annual Report, Chief of Engineers, 1887.)

The river and harbor act of August 11, 1888, authorized the gaugings, and provided for them as follows:

> And the Secretary of War shall cause such gaugings to be made at or near St. Paul during the annual operation of said reservoirs as shall determine accurately the discharge at that point, the cost of the same to be paid out of the annual appropriation for gauging the waters of the Mississippi River and its tributaries.

* * * * * * *

SEC. 6. That for the purpose of securing the uninterrupted gauging of the waters of the Lower Mississippi River and its tributaries, as provided for in joint resolution of the twenty-first of February, eighteen hundred and seventy-one, upon the application of the Chief of Engineers, the Secretary of War is hereby authorized to draw his warrant or requisition from time to time upon the Secretary of the Treasury for such sums as may be necessary to do such work, not to exceed in the aggregate for each year the amount appropriated in this act for such purpose: *Provided, however,* That an itemized statement of said expenses shall accompany the Annual Report of the Chief of Engineers.

Gaugings were not made until the fall of 1889, although an allotment of $900 for the fiscal year ending June 30, 1889, had been made. On account of the lateness in the season and the condition of the river, it was not deemed advisable to expend any of the money that year.

The allotments of $600, $900, and $900, made for fiscal years 1889–'90, 1890–'91, and 1891–'92, were applied to gauging the Mississippi River at St. Paul; and, when necessary, the Minnesota River at its mouth.

During the past fiscal year 135 gaugings have been made.

July 1, 1891, balance unexpended	$1,179.07
June 30, 1892, amount expended during fiscal year	1,133.85
July 1, 1892, balance unexpended	45.22
July 1, 1892, outstanding liabilities	45.22
Amount allotted for fiscal year ending June 30, 1893	500.00

(See Appendix Z 8.)

EXAMINATION AND SURVEY, MADE IN COMPLIANCE WITH PROVISIONS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Red River of the North and tributaries above Fergus Falls and Crookston, Minnesota, and of Big Stone Lake, Minnesota and South Dakota, with a view to improving navigation thereon by the erection of suitable dams, or by such other means as may be deemed best,* was made by the local engineer in charge, Maj. Jones, and report thereon submitted through Col. O. M. Poe, Corps of Engineers, Division Engineer, Northwest Division. It is the opinion of Maj. Jones, and of the division engineer, based upon the facts and reasons given, that this locality is worthy of improvement. This opinion being concurred by me, Maj. Jones was charged with and has completed its survey and submitted report thereon.

The plan of improvement presented contemplates the formation of two reservoir systems, at Red Lake and Lake Traverse, at the headwaters of tributaries to the Red River of the North, for the purpose of diminishing the effects of floods and of storing water for use at low stages in the Red River system.

The plan for the Red Lake reservoir system contemplates the construction of a reservoir dam, with a lock, in Red Lake River near the outlet of the lake. Navigation up Red Lake River to the lake is to be provided for by the construction of locks and dams at Crookston and Thief River.

The plan for the Lake Traverse reservoir system contemplates the diversion of Otter Tail River into Rabbit and Bois de Sioux rivers, by constructing a dam and canal near Breckenridge; construction of a dam and lock in Bois de Sioux River below the mouth of the Rabbit; and construction of a dam at the foot of Big Stone Lake, and excavation of a canal to connect Big Stone Lake with Lake Traverse.

The estimated cost of these works, not including flowage damages, is as follows:

Red Lake system:		
Red Lake dam and lock	$150,000	
Dam and lock near Thief River	150,000	
		$300,000
Lake Traverse system:		
Dam and lock in Bois de Sioux River below Rabbit River	150,000	
Canal between Otter Tail River and Rabbit River, near Breckenridge	60,000	
Dam across Otter Tail River	20,000	
Dam at foot of Big Stone Lake	150,000	
Canal between Big Stone Lake and Lake Traverse	30,000	
		410,000
Surveys and contingencies		150,000
Total		860,000

Maj. Jones also suggests that a canal 55 miles long could be constructed from Red Lake to Rainy Lake River (which empties into the Lake of the Woods), extending navigation to that region, at a cost of about $15,000 per mile.

The amount of commerce on the Red River of the North does not justify undertaking a project of this magnitude, and in my opinion the river is not worthy of improvement to this extent by the General Government.

The reports were transmitted to Congress and printed as House Ex. Doc. No. 127, Fifty-second Congress, first session. (See also Appendix Z 9.)

IMPROVEMENT OF MISSOURI RIVER ABOVE SIOUX CITY, IOWA, AND OF YELLOWSTONE RIVER, MONTANA AND NORTH DAKOTA.

Officer in charge, Capt. Charles F. Powell, Corps of Engineers; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Missouri River between the Great Falls, Montana, and Sioux City, Iowa.*—The river above Fort Benton, the head of navigation, to the foot of the falls is seriously obstructed by numerous rapids and rocks. This part of the river is the tailing out of the Great Falls. No work has been done upon it and none is proposed.

From Fort Benton to Carroll, Mont., called the Rocky River, 168 miles long, the channel was originally obstructed by bowlders, short turns and sharp slopes, and insufficient low water depth on bars for 30-inch draft boats. The original project was to remove obstructive bowlders. To this was added the building of cut-off and wing dams for causing scour of the bottom, or lengthening of the slopes by raising the water at their lower ends, or for both these objects. Dredging was also added to the project.

To June 30, 1891, $329,580.32 had been expended thereon. To that date the most obstructive bowlders had been removed, some dams built, and dredging done, giving a 3-foot or deeper channel at the improved places, except at extreme low water, for part of the places.

During the year ending June 30, 1892, 5 dams were repaired or extended, 4 dams or sills built, bank protection was made at one place, channels dredged through three bars, and 251 bowlders, averaging about one-half cubic yard in size, were removed.

On the Sandy River, viz, below Carroll, the river becomes more and more unstable going downstream, and carries more and more sediment, until at Sioux City it is called the "Big Muddy," the banks in the bottoms cave, numerous shoals exist, floods and ice gorges occasionally cause cut-offs or radical shiftings of the channel, and snags and bowlders obstruct it. The project here is to remove snags, wrecks, and other obstructions, and to temporarily improve the worst crossings, on which project to June 30, 1891, $42,604.10 had been expended.

During the year ending June 30, 1891, 322 snags, 3 ponton-bridge stone sinkers, and 312 bank trees or stumps were removed; also a channel was opened by steamboat sluicing through a bad bar near Washburn, N. Dak., last October.

A detailed hydrographic and topographic survey of the river and banks to the highlands from Fort Benton, Mont., to Sioux City, Iowa, is in execution. The survey is based on a system of triangulation between river bluffs and a duplicated line of primary levels. A series of small-scale maps and one of large-scale detail charts are being made. To June 30, 1891, $81,534.59 had been expended on the river survey.

During the year ending June 30, 1892, bench marks were placed and primary levels run from Poplar Creek, Montana, to Fairbank, S. Dak., 574 miles; tertiary triangulation, hydrography, and topography were completed from Wolf Point, Mont., to next below Cannon Ball, N. Dak., 461 miles; the triangulation and back topography were run from end of the completed work to Fairbank, S. Dak., 144 miles; 63 detail charts, from Fort Benton to Wolf Point were completed and 51 of them placed with the printer for publication; preliminary or small-scale chart No. 1 was completed, except title, and No. 2 one-half finished; the 8 preliminary maps from Wolf Point to Cannon Ball were penciled, and the 58 detail charts of the same series three-fourths finished.

The location for an ice harbor at Rock Haven, near Mandan, having been approved, was surveyed; it is expected to improve the locality this fall for the purpose stated.

The engineer in charge recommends the rectification and permanent channel improvement of the river at Pierre and Fort Pierre, S. Dak.; the Bismarck reach, North Dakota, 25 miles, and the Yankton-Sioux City reach, South Dakota and Nebraska, 130 miles, for reasons for which see appendix.

July 1, 1891, balance unexpended	$267,896.11
June 30, 1892, amount expended during fiscal year	156.909.30
July 1, 1892, balance unexpended	110,986.81
July 1, 1892, outstanding liabilities	17,721.47
July 1, 1892, balance available	93,265.34
Amount appropriated by act approved July 13, 1892	150,000.00
Amount available for fiscal year ending June 30, 1893	243,265.34
Amount (estimated) required for completion of existing project*	175,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A A 1.)

2. *Yellowstone River, Montana and North Dakota.*—The project consists in rock removal and building closing dams and wing dams for confining the water to one channel, from Glendive, Mont., to the mouth of the river. The amount expended thereon to June 30, 1891, is $106,983.80.

The channel was originally obstructed by rocks, and also, and now in part, by swift rapids, sharp turns, and insufficient depths at bars.

---

* This amount includes estimate for bank protection authorized by river and harbor act approved July 13, 1892.

July 1, 1891, balance unexpended	$11,766.20
June 30, 1892, amount expended during fiscal year	45.33
July 1, 1892, balance unexpended	11,720.87
July 1, 1892, outstanding liabilities	.71
July 1, 1892, balance available	11,720.16
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	106,000.00

(See Appendix A A 2.)

EXAMINATION, MADE IN COMPLIANCE WITH PROVISIONS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Missouri River, Montana, between Great Falls and canyon next below Stubbs Ferry*, was made by the local engineer in charge, Capt. Powell, and report thereon submitted through Col. O. M. Poe, Corps of Engineers, Division Engineer, Northwest Division. It is the opinion of Capt. Powell and of the division engineer, based upon the facts and reasons given, that this locality is worthy of improvement, and this opinion was concurred in by me. No new survey of this reach of Missouri River is necessary at this time; but in order to obtain use of the results of surveys heretofore made, an allotment was made for preparation of maps, and a final report, with plan and estimate for improvement, has been submitted.

The plan of improvement proposed contemplates (1) removal of snags from the reach of river extending up from Great Falls, 51 miles, known as the "long pool," which now admits 3-foot navigation at low stages, and from a few miles above; (2) construction of 2,000 feet of dams and 3,500 feet of bank protection, so as to extend the 3-foot channel 4 miles farther to the towns of Cascade and St. Clair; and (3) construction of 10,000 feet of dams, removal of bowlders and rock, and marking other bowlders and rock with buoys, on the next reach of 60 or 70 miles up to the cañon next below Stubbs Ferry, so as to provide a channel with a least depth of 2.5 feet at low water.

The cost of this work is estimated as follows:

Snagging	$200.00
Construction of dams, 12,000 feet	90,000.00
Construction of bank protection, 3,500 feet	17,500.00
Removal of rock and bowlders	8,040.00
Placing of ten buoys	97.50
Total	115,837.50

It is estimated that the maintenance of this work will cost $4,500 annually.

The reports were transmitted to Congress and printed as House Ex. Doc. No. 114, Fifty-second Congress, first session. (See also Appendix A A 3.)

IMPROVEMENT OF TENNESSEE RIVER ABOVE CHATTANOOGA, TENNESSEE, AND BELOW BEE TREE SHOALS, ALABAMA; OF CUMBERLAND RIVER, TENNESSEE AND KENTUCKY, AND OF THEIR TRIBUTARIES IN EASTERN TENNESSEE AND KENTUCKY.

Officers in charge, Lieut. Col. J. W. Barlow, Corps of Engineers, to October 23, 1891, and Lieut. Col. Henry M. Robert, Corps of Engineers, since that date, with Lieut. John Biddle, Corps of Engineers, under their immediate orders.

1. Tennessee River.—a. Above Chattanooga, Tennessee (188 miles).—This section of the river extends from the mouth of the French Broad River to Chattanooga, and is usually navigable during the winter and spring months. Examinations were made in 1830 and 1871. The obstructions were described as "low-water obstructions," consisting of reefs, rock or gravel bars, and snags, etc., brought down by freshets. The depth on these bars varies from 10 to 30 inches at a low-water stage; the current being from 2½ to 6 miles per hour.

The original project, under which the work is still carried on, was to blast a channel through the reefs, reduce the gravel and sand bars, and to deepen the water on the bars by the construction of wing dams, thus contracting the water way so as to secure a safe, navigable channel, 3 feet in depth at average low water.

The amount expended to June 30, 1891, including outstanding indebtedness, was $253,891.33, which expenditure has resulted in securing a lengthened season of navigation for steamboats and a safer channel for the passage of rafts and flatboats. Of the forty-three obstructions enumerated in 1830, channel work has been carried on to the extent of improving at least twenty-nine of them. Owing to the character of the banks these improvements are practically permanent.

At White Creek Shoals the longitudinal dam was lengthened and two spur dams built, causing the removal of the sand bar to deep water. The comprehensive survey "from Chattanooga, Tenn., to the junction of the Holston and French Broad rivers" provided for by act of September 19, 1890, was begun in May, 1891, under the local charge of First Lieut. John Biddle, Corps of Engineers, and was carried to Concord, about 25 miles, at the close of the fiscal year 1891.

During the present fiscal year this survey was extended to Chattanooga, 188.1 miles from the initial point. The field work was finished October 31, 1891. The preparation of maps of the survey, whereon to base the required estimates and project for improvement are well advanced, and report will he rendered as soon as practicable.

In July the channel at Soddy Shoals was carefully examined and preparations made for drilling and blasting the rock forming the dangerous reefs of this obstruction. Three dams were also repaired. High water and frequent rises during the season greatly hindered the progress of the work, which was entirely suspended in November. Engineer property pertaining to the Tennessee River and the upper tributaries was then moved to Chattanooga for winter moorings as a measure of economy and safety.

Amount expended during the fiscal year, including outstanding indebtedness, was $17,821.80, as follows:

General improvement	$7,077.03
Survey from Chattanooga to junction of Holston and French Broad rivers	10,744.77
July 1, 1891, balance unexpended	19,518.70
June 30, 1892, amount expended during fiscal year	17,675.77
July 1, 1892, balance unexpended	1,842.93
July 1, 1892, outstanding liabilities	146.03
July 1, 1892, balance available	1,696.90
Amount appropriated by act approved July 13, 1892	25,000.00
Amount available for fiscal year ending June 30, 1893	26,696.90
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	44,000.00

b. Below Bee Tree Shoals, Alabama (*225 miles*).—This section of the river is generally navigable during the greater part of the year, though several obstructions render navigation difficult during the low-water season.

No instrumental survey has been made of this section of the river, nor estimates and project submitted for its improvement, and it is very necessary that such a survey be made to obtain data whereon to base estimates and a project for the improvement of the Lower Tennessee. The work required to be done is channel excavation and construction of wing dams to widen, straighten, and deepen the channel at the principal obstructions.

The act of September 19, 1890, appropriated $25,000 for the preservation of Livingston Point, Kentucky, which, with two small islands, forms Paducah Harbor, at the mouth of the river. The plan of improvement adopted consisted in covering the wearing slopes of the banks with a revetment of stone and brush and the construction of a pile and stone dike along the crest of the weakest part of the point, where the Ohio cuts through at high stages of the river. Contract was made for building a part of the dike, including necessary shore protection, and work was begun in May, 1891.

The sum of $1,327.21, including outstanding indebtedness, had been expended in dike construction at the close of the fiscal year ending June 30, 1891.

During the present fiscal year the work of dike construction and bank protection was continued under contract until September 23, 1891, when the contract was terminated. The dike on the Ohio side was built for a distance of 660 feet across the washout near the extremity of the point. The bank protection covers a length of 2,330 feet, the average width being 47 feet.

The amount expended during the fiscal year was $21,797.34.

Twenty-five thousand dollars has been allotted for work at Livingston Point from appropriation of July 13, 1892, for improving Tennessee River below Chattanooga, making an available amount for fiscal year ending June 30, 1893, of $27,035.70. The amount (estimated) required for completing the existing project is $130,000.

The money statement is included in that for improvement of Tennessee River below Chattanooga, page 275.

(See Appendix B B 1.)

2. Hiawassee River, Tennessee.—This stream rises in the Blue Ridge, in North Carolina and Georgia. It flows in a west-northwesterly direction, and enters the Tennessee River about 36 miles above Chattanooga. On examination made in 1874 the channel was found to be obstructed by rock reefs, gravel bars, snags, and overhanging trees.

The present project consists in narrowing the water way at the shoal places by building wing dams and excavating the reef and gravel bars and removing surface obstructions, so as to secure a channel 40 feet wide and 2 feet deep at ordinary low water from Savannah Ford to the mouth of the river, about 43 miles.

The amount expended to June 30, 1891, including outstanding indebtness, was $34,951.53, and has resulted in a partial improvement of the river, securing an increased depth in channel and the removal of surface obstructions principally below Charleston.

Channel work was resumed during June, 1892, at Matthew Shoals; 65 overhanging trees were cut down, high water preventing work in channel.

The amount expended during the fiscal year, including outstanding indebtedness, was $425.29.

Work on the dams will be begun as soon as practicable.

July 1, 1891, balance unexpended	$1,586.51
June 30, 1892, amount expended during fiscal year	94.24
July 1, 1892, balance unexpended	1,492.27
July 1, 1892, outstanding liabilities	331.05
July 1, 1892, balance available	1,161.22

(See Appendix B B 2.)

3. *French Broad River, Tennessee.*—This stream rises on the western slopes of the Blue Ridge, in North Carolina, and enters the State of Tennessee at Paint Rock, and after a course of 121 miles in that State joins the Holston about 5 miles above Knoxville, thus forming the Tennessee River.

By examinations made in 1871 and 1875 the river was found to be obstructed by rock reefs, sand and gravel bars, and surface obstructions, such as bowlders, snags, and overhanging trees. It was not deemed practicable to improve the river above Leadvale, but from this point to the mouth, a distance of about 90 miles, it is projected to remove all surface obstructions, and by excavation and the use of wing dams to secure for this distance a channel depth of 2½ feet at ordinary low water. Above the mouth of Nolichucky River (Leadvale) to the boundary line of Tennessee and North Carolina a system of locks and dams is the only feasible improvement, but the amount of commerce does not warrant such an expenditure.

The amount expended to June 30, 1891, including outstanding indebtedness, was $41,301.11. This expenditure has resulted in the improvement of ten of the principal obstructions below Dandridge, by deepening and clearing the channel, constructing and modifying wing dams, and revetting the banks where necessary. At Seven Island Shoals the improvements have made upstream navigation possible at lower stages of the river. A general deepening of the channel from 6 to 10 inches has been obtained.

During the present fiscal year work was carried on at Bryant Shoals and Hanging Rock Shoals. At Bryant Shoals the old dam at foot of McCroskey Island was lengthened 50 feet, and two new dams built out from north bank, having a total length of 442 feet, to assist in reducing the gravel bars at foot of the island. A third dam, 306 feet long, was built across the chute south of the island, closing the chute and thus submerging and cutting a channel through the bar at the mouth of Pigeon River. At Hanging Rock Shoals the channel was changed from the north to the south side of Brabson Island without causing detention to boats. Eight dams were built, aggregating a length of 2,694 linear feet; a retaining dam, with two spur dams, at foot of Brabson Island; one dam, an extension of an existing fish-trap, and two new dams on south shore of island, and two dams from head of island to north bank, closing the old channel. The work has proved effective, but is not completed, additional dams being required. Operations were suspended early in November, the available funds being exhausted.

The amount expended during the fiscal year, including outstanding indebtedness, was $8,129.70.

July 1, 1891, balance unexpended	$8,145.46
June 30, 1892, amount expended during fiscal year	7,956.07
July 1, 1892, balance unexpended	189.39
July 1, 1892, outstanding liabilities	173.63
July 1, 1892, balance available	15.76
Amount appropriated by act approved July 13, 1892*	15,000.00
Amount available for fiscal year ending June 30, 1893	15,015.76
Amount (estimated) required for completion of existing project	88,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix B B 3.)

4. Clinch River, Tennessee.—This stream rises in the Cumberland Mountains in Virginia, and after following a southwesterly course for about 400 miles, empties into the Tennessee River at Kingston, 104 miles above Chattanooga. About 230 miles of the river flows in the State of Tennessee.

An examination was made in 1875, when the channel obstructions were found to be rock reefs, sand and gravel bars, snags, and overhanging trees.

The present project provides for channel excavation, removing surface obstructions, and the construction of wing dams, so as to secure a safe navigable channel of 2 feet at average low water from mouth of river to Clinton, about 70 miles, and of 1½ feet from Clinton to Haynes or Walkers Ferry, about 75 miles.

From Haynes to the Tennessee State line, 85 miles, the only work practicable is to remove the loose rock, and reduce the rock ledges, thus to assist flatboat navigation during "rain-tides."

The total amount expended to the close of the fiscal year ending June 30, 1891, was $31,964.09, and has resulted in securing a reduction of the rock reefs, the removal of snags, drift, etc., brought down by the annual floods, and the construction of several heavy riprap dams above and below Haynes; a safe channel was secured at stages of the water from 2 to 3 feet lower than before the improvements were begun. Special advantages have been gained at Cloud Shoals, Hibb Shoals, Black Shoals, and Bletcher Shoals. Above Haynes, improvements were made at Hunter Shoals, Sycamore Shoals, and Hopson Shoals.

The amount expended during the present fiscal year, including outstanding indebtedness, was $3,472.99, which was used principally at Llewellyn Shoals and Youngs Island, in channel excavation and construction of riprap dams. Llewellyn Shoals are now reported as navigable at a stage of water 1 foot or 1½ feet lower than before operations were begun in July of the present fiscal year.

July 1, 1891, balance unexpended	$3,510.70
June 30, 1892, amount expended during fiscal year	3,399.15
July 1, 1892, balance unexpended	111.55
July 1, 1892, outstanding liabilities	73.84
July 1, 1892, balance available	37.71
Amount appropriated by act approved July 13, 1892	4,000.00
Amount available for fiscal year ending June 30, 1893	4,037.71

---

*One thousand dollars of this appropriation is to be used in removing bar in Little Pigeon River.

Amount (estimated) required for completion of existing project	$11,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B B 4.)

5. *Cumberland River, Tennessee and Kentucky.—a. Below Nashville* (*191 miles*).—An examination was made of this section in 1871, upon which the original project of improvement was based. The project was modified in 1888 by the recommendation of a Board of Engineers to improve navigation at the mouth of the river by the construction of a pile and stone dike, for which Congress made provision in river and harbor act of September 19, 1890. A survey was made of the Cumberland River below Nashville in 1889 "to ascertain if necessary to establish locks and dams."

In 1871 the obstructions were found to be of the same general character throughout, consisting of rock reefs, sand and gravel bars, bowlders, snags, and overhanging trees, and other surface obstructions. The project comprises the deepening of the channel by excavation and the use of wing dams; the removing of snags and surface obstructions, and the modifying of the channel at the mouth of the Cumberland, from Smithland to the deep waters of the Ohio, by the construction of a pile dike with crib superstructure.

The total amount expended to June 30, 1891, including outstanding indebtedness, was $267,257.10, and this expenditure has resulted in obtaining an increased depth at low water at some of the worst obstructions, and thereby securing a lengthened season of navigation, and from year to year the channel was cleared of snags and other surface obstructions.

During the present fiscal year, from July until December, the snag-boat *Weitzel* was employed in clearing the river below Nashville, removing a large number of snags, sunken logs, and overhanging trees, and also two old sunken hulls, reducing rock points, sand and gravel bars in channel, and placing buoys on dams to mark their location at high-water stages.

From August to December the work of dike construction was continued under contract at mouth of the river; 1,081 piles were driven, and 10,045.45 cubic yards of stone, and 1,636.89 cords of brush, were placed in dike and as shore protection.

The amount expended during the fiscal year, including outstanding indebtedness, was $21,435.69, as follows: For "general improvement," $7,413.80, and for "at mouth of river," $14,021.89.

July 1, 1891, balance unexpended		$38,740.99
June 30, 1892, amount expended during fiscal year		21,278.83
July 1, 1892, balance unexpended		17,462.16
July 1, 1892, outstanding liabilities	$156.86	
July 1, 1892, amount covered by uncompleted contracts	5,370.91	
		5,527.77
July 1, 1892, balance available		11,934.39
Amount appropriated by act approved July 13, 1892		40,000.00
Amount available for fiscal year ending June 30, 1893		51,934.39
Amount (estimated) required for completion of existing project		153,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

b. Above Nashville.—From Nashville to head of Smith Shoals (*337 miles*).—The present project is based on an instrumental survey of this section made in 1883, and provides for the complete canalization of the river from Nashville to head of Smith Shoals, by the construction of 23 locks and dams below Burnside, and 7 locks and 2 dams at Smith Shoals, at an estimated cost of $7,500,000; of this amount $775,000 has been appropriated and the amount expended to June 30, 1891, including outstanding indebtedness, was as follows: For channel work $12,212.52, for canal work $64,927.93; total, $77,140.45, which sum was applied to purchases of sites of locks, dams, and lock-keepers' houses at Locks Nos. 1 and 2; construction of lock-keeper's house, building coffer dam and excavating pit of Lock 1, and payments on stone for masonry of lock and abutment, and contingencies pertaining to entire work under contract; and to rebuilding and refitting snag-boat *Weitzel*, clearing the channel of snags, reducing rock and gravel bars, and extending and repairing riprap dams to maintain the improvements already secured.

During the present fiscal year the channel was cleared of snags, etc., below the mouth of Caney Fork River by the snag boat *Weitzel* and the snagging party moving down the Cumberland River having completed the season's operations on the Caney Fork River; the cost of this work, $1,547.56, was paid for from the appropriation of August 2, 1882, for improving Cumberland River above mouth of the Jellico, Kentucky, and made available for this purpose by act of September 19, 1890. At the close of the year a steam-derrick boat and quarter boat were fitted up for snagging and repairing dams of the upper Cumberland; work was begun at Orchard Landing, 250 miles above Nashville on June 18, and on June 30 reached Neely Shoals, having worked over a reach of 24 miles of river. Operations in channel will be continued down stream. Examinations were made in June of the obstructions at Salt Lick Island, Holliman Island, and Bartlett Shoals, the channel being badly obstructed at those points.

Four contracts were in force during the fiscal year, and operations were continued upon Locks Nos. 1 and 2 and abutment of Dam 1 during the first half of the year, and the following work was done at Lock 1: One thousand four hundred and twenty-seven cubic yards of earth and 2,030 cubic yards of rock were excavated, and 4,447 cubic yards of masonry laid; at abutment, Dam 1, 5,093 cubic yards of earth and 10 cubic yards of rock excavated and 407 cubic yards of masonry laid; at Lock 2, 11,949 cubic yards of earth and 616 cubic yards of rock excavated. Continued high water caused a total suspension of operations from December until the middle of June, when the work of excavation was renewed at abutment of Dam 1.

The total amount expended during the present fiscal year, including outstanding indebtedness, was $66,357.86.

Actual operations having established the fact that solid rock can not be found for the foundation of Lock No. 2 at anything like the depths specified in the contract, and that the character of the site at the depths so specified is altogether too insecure for the masonry of the lock, the contract of February 24, 1891, with Messrs. Rich and Holmes, for building Lock No. 2, will be terminated, in accordance with its provisions for such termination. At the close of the fiscal year this matter was in process of adjustment.

The intent of the proposed system of locks and dams being to reach the coal fields and to develop the coal trade of the Upper Cumberland, and to provide a safe and uninterrupted channel for the same, the engineer officer in charge recommended that operations be begun at Smith Shoals, in accordance with the legislation of the act of Congress of September 19, 1890, appropriating money for work at that obstruction, thereby to connect the coal region with the Cumberland at the present head of navigation at Burnside, Ky., as soon as practicable. This recommendation was approved, and the preliminary arrangements are now in progress for organizing the necessary survey party to examine the shoals, and take observations to determine the volume and velocity of the currents, and steps will be taken as soon as practicable to select sites and acquire title to the necessary lands, etc. In order to maintain an open river the lower dams of the series will not be constructed until they are required as aids to navigation, which will not be until a large number of the lower locks are built, provision being made for clearing the river of surface obstructions from year to year and maintaining the improvements already secured at several localities.

July 1, 1891, balance unexpended		$448,318.60
June 30, 1892, amount expended during fiscal year		64,901.49
July 1, 1892, balance unexpended		383,417.11
July 1, 1892, outside liabilities	1,456.37	
July 1, 1892, amount covered by uncompleted contracts	220,882.53	
		222,338.90
July 1, 1892, balance available		161,078.21
Amount appropriated by act approved July 13, 1892		250,000.00
Amount available for fiscal year ending June 30, 1893		411,078.21
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		6,725,000.00

c. Above mouth of the Jellico, Kentucky.—Under the provisions of the act of September 19, 1890, $4,922.02 of the $5,000 appropriated by act of August 2, 1882, has been expended in the removal of snags and sand bars in the Cumberland River above Nashville, of which sum $1,547.56 was expended during the present fiscal year.

July 1, 1891, balance unexpended	$1,625.54
June 30, 1892, amount expended during fiscal year	1,547.56
July 1, 1892, balance unexpended	77.98

(See Appendix B B 5.)

6. *Caney Fork River, Tennessee.*—This stream, after a course of about 200 miles wholly in the State of Tennessee, empties into the Cumberland River at Carthage, Tenn., about 116 miles above Nashville, Tenn. It is the largest and one of the important tributaries of the Cumberland River.

An examination was made in 1879 as high up as Sligo Ford, about 72 miles, and in 1886 it was extended 20 miles farther to Frank Ferry, the head of navigation. The principal difficulties were found to be rock reefs, gravel, and sand bars, a crooked, shallow channel, greatly impeded by surface obstructions.

The present project is to improve the river below Frank Ferry, 92 miles, by removing drift and other surface obstructions, and in building the wing dams and training walls necessary to insure safe navigation for small steamboats and flatboats during the boating season, usually about five months in duration, from February to July.

The amount expended to June 30, 1891, including outstanding indebtedness, was $23,353.49, which was used in removing surface obstructions, in reducing sand and gravel bars, and in repairing and building dams, and has resulted in a greatly improved channel at the 3-foot stage above low water from Frank Ferry to Mine Lick Shoals, about 32 miles.

Work in the channel was in progress at the close of the last fiscal year and was continued until August 15, 1891, when active operations were suspended, the appropriation being nearly exhausted. The work consisted of clearing the channel of surface obstructions from Mine Lick Island to mouth of the river, about 60 miles. Thirty cubic yards of rock and 227 snags were taken out and 5,969 overhanging trees were removed or deadened. Amount expended during the fiscal year, including outstanding indebtedness, was $2,501.86.

July 1, 1891, balance unexpended	$2,535.24
June 30, 1892, amount expended during fiscal year	2,481.86
July 1, 1892, balance unexpended	53.38
July 1, 1892, outstanding liabilities	20.00
July 1, 1892, balance available	33.38
Amount (estimated) required for completion of existing project	20,228.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B B 6.)

7. *South Fork of Cumberland River, Kentucky.*—This stream is a tributary of the Cumberland River, which it enters at Burnside, Ky., and about 325 miles above Nashville.

An examination was made in 1880. Its upper waters were found to be so greatly obstructed by immense sandstone bowlders as to render improvement impracticable. The lower river from Devils Jumps to mouth, a distance of about 44 miles, was considered worthy of improvement, and the project adopted sought to obtain a safe channel for flatboats and rafts at a 3-foot stage above low water by clearing the channel of surface obstructions and by the construction of wing dams, to deepen the water on the sand and gravel bars below the Devils Jumps.

The amount expended to June 30, 1891, including outstanding indebtedness, was $11,968.94, the expenditure of which resulted in obtaining safe navigation for rafts and flatboats for a distance of about 16 miles from its mouth. Work in channel was suspended in September, 1887. There were no disbursements made during the fiscal year ending June 30, 1892.

July 1, 1891, balance unexpended	$41.03
July 1, 1892, balance unexpended	41.03
July 1, 1892, outstanding liabilities	9.97
July 1, 1892, balance available	31.06
Amount (estimated) required for completion of existing project	50,803.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B B 7.)

IMPROVEMENT OF TENNESSEE RIVER BETWEEN CHATTANOOGA, TENNESSEE, AND FOOT OF BEE TREE SHOALS, ALABAMA.

Officer in charge, Capt. George W. Goethals, Corps of Engineers; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Tennessee River between Chattanooga, Tennessee, and foot of Bee Tree Shoals, Alabama.*—The original condition of the river from Chattanooga to Browns Ferry, when examined in 1867 and subsequently, was found to be obstructed by rock reefs, bars, bowlders, and pro-

jecting rocky points, permitting navigation from six to nine months in the year. From Browns Ferry to Florence it was not navigable except at unusually high-water stages because of the Muscle Shoals obstructions. From Florence to Riverton, Colbert and Bee Tree Shoals limited navigation to about six months in the year.

The present project consists in:

a. Removing obstructions by blasting and dredging in "The Suck" and at Bridgeport and Guntersville, Ala.

b. Building a canal 14.5 miles long, 70 to 120 feet wide, and 6 feet deep around the Big Muscle Shoals, having 9 locks, each 60 by 300 feet, and an aqueduct over Shoal Creek 900 feet long and 60 feet wide; constructing a canal 1.5 miles long with 2 locks around Elk River Shoals.

c. Blasting a channel through bed rock and building wing dams at Little Muscle Shoals; as modified in 1890, the project contemplates the building of a canal along the south bank, 3 miles long, with two locks.

d. Constructing a canal 7.8 miles long, 150 feet wide and 7 feet deep, around Colbert and Bee Tree Shoals, with 2 locks with lifts of 12 and 13 feet, respectively, near lower end and guard lock at the head; size of locks, 80 by 350 feet.

The total amount expended to June 30, 1891, including outstanding liabilities, was $3,357,539.34, and resulted in the improvement of the river as follows:

Navigation was made easier through the "Suck" and "Pan" by removal of bowlders, detached rock, overhanging trees, and projecting rocky points. Survey of "Suck" begun. At Elk River Shoals and Big Muscle Shoals the locks, gates, valves, and machinery for properly operating them were completed, the aqueduct and permanent stone dams finished, and the canal opened to navigation. At Little Muscle Shoals the channel was excavated and the wing dams built as originally projected. At Colbert and Bee Tree Shoals, channel excavation and building stone dams to contract water way have resulted in increased depth; survey for location of proposed lateral canal begun.

The amount expended during the fiscal year, including outstanding liabilities, was $194,562.93, for which the following work was done:

At the "Suck."—The survey, covering a distance of 32 miles, was completed. The necessary plant was procured, the channel below Tumbling Shoals straightened, and the cross section of the river from head of Tumbling Shoals to the head of the "Suck" was increased by removal of bowlders and trees along the banks up to high-water mark. A contract was made for excavating a channel through Guntersville Reef.

At Elk River Shoals.—The completion of the drift sluice in the longitudinal dam, operated by the Parker automatic gate. Six hundred and fifty feet of the longitudinal dam that remained incomplete was finished up to grade. Below Lock B the channel was deepened and widened by dredging and blasting. The excavation through Nance Reef was completed. Lock-keepers' houses were built at Locks A and B.

At Big Muscle Shoals.—Lock-keepers' houses were built at Locks 2, 3, 4, 5, 6, and 9, and assistant lock-keepers' houses were erected at Locks 3, 6, and 9. A house for the storage of property was built at Lock 6. About 5 miles of the railway along the towpath was rebuilt, completing the reconstruction of the track; all the bridges along the line were strengthened by lateral bracing, Blue Water bridge remodeled, and a new bridge put up across Shoal Creek. Stone was quarried and crushed at Lock 4 quarry, and the product used for ballasting railway and paving inner slope of embankment; 4.3 miles was thus paved. Eleven thousand five hundred and forty-nine linear feet of drainage ditches was opened to empty sloughs in the bottoms. A Bucyrus dredge was completed under contract and is in operation. A light-draft towboat was built. Land for lock-keepers' houses was purchased at Locks 5 and 9; and 20 acres damaged by overflow from the canal at the mouth of Second Creek were bought.

At Colbert and Bee Tree Shoals.—The survey for location of the proposed lateral canal completed and maps platted. Center line permanently marked by stone monuments. Negotiations were made for the purchase of 309 acres of land required for the improvement. The lower lock was staked off and test pits sunk to rock under the gate abutments.

The money statement for this work is consolidated with that for Tennessee River below Bee Tree Shoals, page 267, so as to embrace the entire reach of the river below Chattanooga, as follows:

Tennessee River below Chattanooga.

July 1, 1891, balance unexpended		$349,885.56
June 30, 1892, amount expended during fiscal year		196,495.95
July 1, 1892, balance unexpended		153,389.61
July 1, 1892, outstanding liabilities	$19,864.32	
July 1, 1892, amount covered by uncompleted contracts	2,800.00	
		22,664.32
July 1, 1892, balance available		130,725.29
Amount appropriated by act approved July 13, 1892		500,000.00
Amount available for fiscal year ending June 30, 1893		630,725.29
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		5,837,939.81

(See Appendix C C 1.)

2. *Operating and care of Muscle Shoals Canal, Tennessee River.*—The canal, opened November 10, 1890, has been in constant use. The number of steamboats, barges, and miscellaneous craft, exclusive of Government boats engaged on the work, that passed through during the fiscal year was 132.

Two serious breaks occurred during the year, one at the west abutment of Six-Mile Dam, and one at the northeast abutment of the aqueduct; both were promptly repaired. Two balanced valves were put in filling culverts of Lock 6, and a counterbalanced slide valve in Lock 7; these were to replace worn-out slide valves. Twenty-eight thousand one hundred and sixty cubic yards of sediment was removed from the canal.

The total expenses incurred during the year were $40,232.90. Estimated expenses for 1892-'93, $60,000.

(See Appendix C C 2.)

IMPROVEMENT OF OHIO, MONONGAHELA, CHEAT, ALLEGHENY, AND MUSKINGUM RIVERS.

Officers in charge, Lieut. Col. Wm. E. Merrill, Corps of Engineers, to December 14, 1891; Maj. D. W. Lockwood, Corps of Engineers, from December 15, 1891, to February 1, 1892, and Maj. Amos Stickney, Corps of Engineers, since February 1, 1892, with Lieut. Cassius E. Gillette, Corps of Engineers, under their immediate orders to April 20, 1892.

1. *Ohio River.*—The original condition of the navigable channel of

the Ohio River was, that navigation was almost entirely suspended during low water by snags, ripples, rocks, sand and gravel bars, and other obstructions.

The originally adopted project for improving the navigation of the Ohio River was the removal of snags, wrecks, and other obstructions, and the construction of low dams and dikes at islands and sand bars, to confine the current to a smaller cross section. A snag boat and two dredges, all of them having iron hulls, and owned by the United States, find constant employment in taking out snags and wrecks and in dredging away gravel and rock bars that can not otherwise be removed.

An additional project for the radical improvement of the river by movable dams has been begun by the construction of one movable dam at Davis Island, 5 miles below Pittsburg, Pa. The construction of another, which will be number six in the series, has been commenced near Beaver, Pa., 29½ miles below Pittsburg.

Four million eight hundred and twenty-two thousand nine hundred and sixty-two dollars and thirty-six cents has been expended on the improvement of the Ohio River up to the close of the fiscal year ending June 30, 1891.

The condition of the navigable channel of the Ohio River has been greatly improved, as is shown by increased traffic, greater length of time of uninterrupted navigation, etc., but so much depends on the stage of water that it is impossible to give the results in the way of increased depth and advantages derived from amount expended during the last fiscal year.

The following is a summary of the work done during the fiscal year:

Dam between Davis and Neville islands.—Repairs to this dam were completed August 15, 1891.

Dam at head of Marietta Island.—Repairs to this dam were completed October 21, 1891.

Dike at foot of Marietta Island.—This dike was completed October 23, 1891.

Dam at head of Blennerhassett Island.—This dam was completed December 28, 1891.

Dike at Eight-mile Island.—This dike was completed November 19, 1891.

Dike at Cullum.—This dike was completed December 9, 1891.

Dike at lower bar at Rising Sun.—This dike was completed November 25, 1891.

Dike at Madison.—The dike is completed, except a small amount of paving, which could have been done in two weeks had the water permitted. It will probably be finished early in the season.

Dike at Flint Island.—This dike was completed November 25, 1891.

Dike at middle of Grand Chain.—Work was continued whenever the water would permit. The dike is not yet finished.

Rock bar at mouth of Licking River.—The contractor having abandoned his contract, the work was undertaken by the United States. Operations commenced June 5, 1891, and all work projected for the season was completed by November 15, 1891.

Ice pier at Kerr Run.—Was not completed, owing to high water.

Ice pier at Portsmouth.—This ice pier was completed December 4, 1891.

Ice pier at Ripley.—This ice pier was completed October 31, 1891.

Great Miami embankment.—Extension of this embankment to its junction with the Cleveland, Cincinnati, Chicago and St. Louis Railroad has been completed so far as funds available would permit.

Embankment at Shawneetown.—Riprapping and paving of levee, for its protection, was completed April 5, 1892.

Big Hocking River.—The work of improving navigation on this stream is paid for out of the appropriation for the improvement of the Ohio River, and it therefore appears under that heading. The object to be attained is to permit the Ohio River steamboats to ascend to Coolville, 5 miles above the mouth, during high and medium stages of the Ohio, taking advantage of the back water. The work was completed September 1, 1891.

Operations of United States dredges.—The dredges, after undergoing the usual spring repairs at Pittsburg, started down the river July 2, working wherever it was necessary until December 20, when they were put in winter quarters. During the five months they removed from the river between Pittsburg and Louisville 6 wrecks of river craft, 171 piles, 24 snags, 23,232 cubic yards of loose rock and pudding stones, and 81,564.3 cubic yards of gravel.

Removal of rock and other obstructions.—In October a small party was put to work removing dangerous obstructions from the channel between Pittsburg, Pa., and Steubenville, Ohio. During the short time the water permitted them to work they removed 332 cubic yards of rock, the wreck of a coal boat, and some snags.

Encroachments.—Information has been received at various times that parties along the Ohio River were dumping material into the river or over its banks. Investigations have been made, and wherever the parties have persisted in violating the law the matter has been reported to the United States district attorney for his action.

July 1, 1891, balance unexpended		$317,057.10
Sale of property		243.71
		317,300.81
June 30, 1892. amount expended during fiscal year		259,114.37
July 1, 1892, balance unexpended		58,186.44
July 1, 1892, outstanding liabilities	$8,159.99	
July 1, 1892, amount covered by uncompleted contracts	16,331.13	
		24,491.12
July 1, 1892, balance available		33,695.32
Amount appropriated by act approved July 13, 1892		360,000.00
Amount available for fiscal year ending June 30, 1893		393,695.32

(See Appendix D D 1.)

2. *Operating snag boats on Ohio River.*—During 1891 extensive repairs and betterments were made on the snag boat *E. A. Woodruff*. She worked from September 8 to November 22, removing 473 snags, 11 rocks, 1 mass of pudding stones, 3 large pieces of iron (wreckage of the Chesapeake and Ohio Railroad Bridge), and wrecks of 9 steamboats, 24 coal boats, flats, and barges, 1 brick boat, 1 model barge, and one ferry-boat hull. The total distance traveled was 1,396 miles.

(See Appendix D D 2.)

3. *Operating and care of Davis Island Dam, Ohio River, near Pittsburg, Pennsylvania.*—This dam was built to test the adaptability of the system of movable dams to the peculiar condition of the Ohio River and to the special character of the commerce that navigates it. It was intended to be the first step in the radical improvement of the Ohio River, designed to give a minimum depth of 6 feet at all times, except when ice was running. Incidentally this dam has been of great value

to the city of Pittsburg by securing an ample depth of water in its harbor throughout the low-water season. It has also been of immense benefit to the coal trade by enabling them to bring loaded boats out of the Monongahela River at any time. The natural harbor room of Pittsburg is very limited and before the Davis Island Dam was built the great bulk of coal barges were held in the Monongahela. In short rises the amount of coal that could be shipped south was absolutely limited by the number of barges that could be locked through the lowest dam in the Monongahela during the passage of the rise. Under present conditions this limit no longer exists, and all coal can now be shipped for which towboats are available.

During the fiscal year the lock and dam have been operated successfully without the least interference with navigation. The dam has been raised and lowered four times and has been up 115 days during the fiscal year.

(See Appendix D D 3.)

4. *Movable dam in Ohio River below mouth of Beaver River, Pennsylvania.*—The first appropriation for this work was made September 19, 1890, $250,000.

The land necessary for the site of this dam, on both sides of the river, has been acquired, drawings have been prepared, a project for the season's work has been submitted and approved, and the preparatory work for construction of the lock begun.

The amount expended on this work up to the close of the fiscal year ending June 30, 1891, was $1,381.23.

July 1, 1891, balance unexpended	$248,618.77
June 30, 1892, amount expended during fiscal year	5,364.01
July 1, 1892, balance unexpended	243,254.76
July 1, 1892, outstanding liabilities	123.92
July 1, 1892, balance available	243,130.84
Amount appropriated by act approved July 13, 1892	100,000.00
Amount available for fiscal year ending June 30, 1893	343,130.84
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	550,000.00

(See Appendix D D 4.)

5. *Monongahela River, West Virginia and Pennsylvania.*—The seven lower locks and dams on the Monongahela River belong to the Monongahela Navigation Company, and they create slack water from Pittsburg to Dunkard Creek, a distance of 88 miles. Locks and Dams Nos. 8 and 9, belonging to the United States, continue this slack water to Morgantown, W. Va., a further distance of 14 miles, the distance from Pittsburg to Morgantown being 102 miles.

The original condition of the river from the head of slack water of Monongahela Navigation Company to Morgantown was, that it was absolutely unfitted for navigation. In 1871 a very light boat, drawing but 12 inches of water, was built for the express purpose of running to Morgantown. She only succeeded, however, in making five trips in the year.

The originally adopted project for the improvement of this river was the construction of two locks and dams to continue slack water to Morgantown, W. Va. The amount expended thereon up to the close of the fiscal year ending June 30, 1891, was $436,098.34.

The improvement was completed in 1889. A few minor repairs and betterments have been made during the fiscal year ending June 30, 1892. As the cost of operating these locks and dams is a charge against the indefinite appropriation for "operating and care of canals and other works of navigation," reference is made to the report under that heading for further particulars.

July 1, 1891, balance unexpended	$801.66
June 30, 1892, amount expended during fiscal year	443.18
July 1, 1892, balance unexpended	358.48
Amount appropriated by act approved July 13, 1892, for beginning work on Lock and Dam No. 10	25,000.00
Amount available for fiscal year ending June 30, 1893	25,358.48

(See Appendix D D 5.)

6. *Operating and care of Locks and Dams Nos. 8 and 9, Monongahela River.*—These locks and dams have been successfully operated throughout the year, and, while some minor repairs have been made to the dams and operating machinery of the locks, no stoppage to navigation was caused thereby.

(See Appendix D D 6.)

7. *Purchase of Lock and Dam No. 7, Monongahela River.*—The case of the United States *vs.* The Monongahela Navigation Company, for the condemnation of this structure, was heard in the circuit court of the United States for the western district of Pennsylvania, in November, 1890, and the value of the work was fixed by the court at $209,000. The Navigation Company took an appeal to the Supreme Court of the United States, where the matter is still pending.

July 1, 1891, balance unexpended	$161,835.45
July 1, 1892, balance unexpended	161,835.45

(See Appendix D D 7.)

8. *Purchase of Lock and Dam No. 6, Monongahela River.*—Under the act of Congress no steps can be taken towards the condemnation of this lock and dam until the United States has acquired title to Lock and Dam No. 7.

July 1, 1891, balance unexpended	$167,000.00
July 1, 1892, balance unexpended	167,000.00

(See Appendix D D 8.)

9. *Cheat River, West Virginia.*—The channel of this river was originally filled with rock obstructions, which interfered with the free passage of drifting logs, thereby making the transportation of timber from the vast forests at the head waters of this river to the markets along the Monongahela and Ohio rivers very hazardous.

The originally adopted project for the improvement of the river was the removal of rock obstructions that interfered with the free passage of logs on a 6 or 8 foot stage of water for a distance of 30 miles from Rowlesburg to Beaver Hole. This project was modified at the request of those interested in the improvement, and a low-water channel was made from Rowlesburg, 8 miles down the river, in which logs can be floated on a rise of from 2 to 3 feet. The amount expended on the project up to the close of the fiscal year ending June 30, 1891, was $5,108.15. At this time the work was progressing and continued until January 9, 1892, when this appropriation was exhausted. The river is now in fair condition as far down as Green Island, 20¼ miles below Rowlesburg.

July 1, 1891, balance unexpended	$7,891.85
June 30, 1892, amount expended during fiscal year	7,884.35
July 1, 1892, balance unexpended	7.50

(See Appendix D D 9.)

10. Allegheny River, Pennsylvania.—The original condition of the Allegheny River as to depth, width, and navigability, can not be stated in definite figures, as there is no defined plane from which to measure; both the low-water line and the elevation of the river bed being variable.

The approved project for the improvement of the river is the removal of obstructions from the channel and the construction of low dams to close duplicate channels, and of dikes to confine the water way where the river is too wide.

The amount expended on this project up to the close of the fiscal year ending June 30, 1891, was $161,400.12.

Much benefit to navigation has resulted. There was available at the beginning of the fiscal year $18,599.88.

The following work has been done during the fiscal year:

Dam at Cornplanter Island, 204 miles above Pittsburg.—Construction finished.

Dam at Hickory, 157 miles above Pittsburg.—Commenced and finished during the year.

Dam at Pithole, 143 miles above Pittsburg.—Construction finished.

Five hundred cubic yards of rock was removed from the bar at foot of Pithole Ripple, and 621 cubic yards of rock and 11 snags from the channel of the river between Kittanning and Pittsburg.

The construction of these dams and the removal of obstructions has resulted in great good to the general navigation.

Encroachments.—Navigators had frequent occasion to report parties engaged in filling material into the stream. These cases were investigated and guilty parties notified to stop their unlawful practice, which in every case they did.

July 1, 1891, balance unexpended	$18,599.88
June 30, 1892, amount expended during fiscal year	16,977.73
July 1, 1892, balance unexpended	1,622.15
July 1, 1892, outstanding liabilities	163.00
July 1, 1892, balance available	1,459.15
Amount appropriated by act approved July 13, 1892	25,000.00
Amount available for fiscal year ending June 30, 1893	26,459.15

(See Appendix D D 10.)

11. Dam at Herr Island, Allegheny River, near Pittsburg, Pennsylvania.—The object of this dam is to begin a system of slack-water navigation and enlarge the harbor room at Pittsburg to the extent of the pool formed by the dam. The original project was for a fixed dam, but in compliance with the request of the authorities of Pittsburg and Allegheny City, the Secretary of War has ordered that the dam at Herr Island be made a movable one.

The land required, on both banks of the river, was purchased, drawings prepared, and the work of construction was about to begin, when a number of suits for damages were brought in the circuit court of the

United States by riparian owners; these suits are still pending and the construction of this important work delayed thereby.

The amount expended on this work up to the close of the fiscal year ending June 30, 1891, was $36,851.77.

July 1, 1891, balance unexpended	$70,648.23
June 30, 1892, amount expended during fiscal year	1,951.38
July 1, 1892, balance unexpended	68,696.85
Amount appropriated by act approved July 13, 1892	40,000.00
Amount available for fiscal year ending June 30, 1893	108,696.85
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	484,500.00

(See Appendix D D 11.)

12. *Ice harbor at mouth of Muskingum River, Ohio.*—The object of this work was to furnish a place of refuge for Ohio River craft during ice floods.

The project was the construction of a large lock through Dam No. 1, Muskingum River, to permit Ohio River vessels to pass into the pool.

There has been expended thereon, up to the close of the fiscal year ending June 30, 1891, $307,866.78.

The lock was nearly finished and was ready for use December 1, 1891, but it can not be made available for Ohio River craft until a draw is placed in the Baltimore and Ohio Southwestern Railroad bridge, just below it. The time granted the railroad company for completion of the work for providing such draw expired July 1, 1892, and the work has not been done.

July 1, 1891, balance unexpended	$20,114.29
June 30, 1892, amount expended during fiscal year	20,063.51
July 1, 1892, balance unexpended	50.78

(See Appendix D D 12.)

13. *Operating and care of ice-harbor lock at mouth of Muskingum River, Ohio.*—This lock was ready for use December 1, 1891.

An allotment of $1.200 was made December 10, 1891, for its operation and care.

The expenditures during the fiscal year ending June 30, 1892, amounting to $852.98, were for lock-keepers and assistants, and for some minor repairs.

(See Appendix D D 13.)

14. *Muskingum River, Ohio.*—This report is limited to work carried on under the appropriation of August 11, 1888, for the construction of a lock at Taylorsville and the reconstruction of the lock at Zanesville, Ohio.

There was expended thereon up to the close of the fiscal year ending June 30, 1891, $66,867.84.

During the fiscal year ending June 30, 1892, some work was done on the Taylorsville Lock, but this lock can not be made available until a draw is placed in the county bridge, just below it.

The commissioners of Muskingum County, to whom the bridge belongs, were ordered to change it, but thus far they have made no move toawrds obeying the order.

July 1, 1891, balance unexpended	$35, 301. 24
June 30, 1892, amount expended during fiscal year	19, 783. 26
July 1, 1892, balance unexpended	15, 517. 98
July 1, 1892, outstanding liabilities	370. 71
July 1, 1892, balance available	15, 147. 27

(See Appendix D D 14.)

15. *Operating and care of locks and dams on Muskingum River, Ohio.*—As originally improved by the State of Ohio, 11 dams and 12 locks were built on the Muskingum River, furnishing continuous navigation for 91 miles from the Ohio River at Marietta to Dresden, where a connection was made with the Ohio Canal near its middle point, this canal extending from the Ohio River at Portsmouth to Lake Erie at Cleveland. According to old reports from the State board of public works, the locks were built with a length between hollow quoins of 180 feet and a clear width of 36 feet, except the upper lock between Zanesville and Dresden, which had a length of 120 feet and a clear width of 22 feet. The lifts as reported varied from 8 feet 10 inches to 12 feet 1 inch, but measurements made since the United States took charge show that none of the above dimensions were strictly accurate. The work cost the State of Ohio about $1,500,000.

The lock and dam above Zanesville is now in a state of ruin, but the 75 miles of slack water between the Ohio River and Zanesville has always been maintained; on this piece of river there are 10 dams, 11 locks, and 5 lateral canals with a total length of 3⅝ miles.

The locks and dams were about worn out when they passed into the hands of the United States, and a general reconstruction was unavoidable. This work was very greatly retarded and increased in cost by the extraordinary rainfall of the summer and autumn of 1890, which repeatedly carried away cofferdams and drowned out the work. At the close of the fiscal year ending June 30, 1891, the reconstruction of Locks 3, 4, and 8 had been completed. The floods had a very disastrous effect on the dams; Nos. 1, 6, and 8 gave way, and a break took place around the abutment of Dam No. 4. The latter has been thoroughly closed, but it was impossible to do anything for the repair of the broken dams.

There had been expended on this work, up to the close of the fiscal year ending June 30, 1891, $741,863.03.

At the beginning of the fiscal year, the season being a favorable one for work, the repairing and reconstructing of the various locks and dams on the river was progressing.

The reconstruction of Locks Nos. 6 and 7 was completed; Locks Nos. 2 and 5 were completed so far as to admit of their use; the repairs to Dams Nos. 1, 6, and 8 were finished and minor repairs made to Dams Nos. 2, 3, 4, 5, 7, 9, and 10.

Through navigation, which had been interrupted by the closing of locks for repairs in May, 1889, was resumed with the opening of Lock No. 5, May 6, 1892.

An important decision was rendered by Judge Sage of the United States district court, southern district of Ohio, eastern division, relating to the changing of bridges by direction of the Secretary of War, under the provisions of the river and harbor act of September 19, 1890. The decision was in the case of the bridge crossing the Muskingum River at Taylorsville, Ohio, and will be found in full in the annual report of the officer in charge.

(See Appendix D D 15.)

IMPROVEMENT OF FALLS OF THE OHIO RIVER, OF WABASH RIVER, INDIANA AND ILLINOIS, AND OF WHITE RIVER, INDIANA; OPERATING AND CARE OF LOUISVILLE AND PORTLAND CANAL, KENTUCKY.

Officer in charge, Lieut. Col. G. J. Lydecker, Corps of Engineers.

1. *Falls of the Ohio River, at Louisville, Kentucky.*—The improvements in progress under this appropriation contemplate increased facilities for passing the Falls of the Ohio River via the Louisville and Portland Canal by enlargements at its upper entrance and immediately above the locks, so as to form capacious basins, or harbors, at those points. The works involved in the enlargement at the upper end, are also closely associated with the improvement of the Indiana Chute, which seeks to provide a safe open-river channel over the falls, available for the largest tows, when the river is at, or above, a stage of 8 feet on the upper canal gauge.

The project for enlargement at the head was adopted in 1883, and modified, after full consideration, by a board of engineers in 1890. Under this project the width of the canal, now 90 feet, will be increased to from 210 to 325 feet for a length of 2,400 feet, and east of this the enlarged canal will expand into a basin 800 feet wide and 2,200 feet long; the work comprises, as its principal features, the excavation of about 325,670 cubic yards of solid rock, and 270,000 cubic yards of earth, the construction of about 5,200 linear feet of masonry canal wall, and dams, containing about 26,000 cubic yards, and the removal of 6,200 linear feet of old canal wall, dikes, and timber dams. The work accomplished to June 30, 1892, was 166,882 cubic yards of rock excavation; 213,068 cubic yards of earth excavation, and 10,307.5 cubic yards of masonry laid in new canal wall.

The enlargement above the locks was inaugurated in 1887, the purpose being to construct a basin wherein boats can lie, and tows be properly formed before or after passing the locks, without interfering with navigation through the canal. The result of the improvement will be a basin 1,500 feet long with a width varying from 210 to 250 feet. The work is nearly completed. The principal items of work done on this enlargement to June 30, 1892, comprised 141,593 cubic yards of earth excavation, 17,744 cubic yards of rock excavation, and 5,807 cubic yards of canal wall laid.

The total expenditures on these improvements up to the close of the fiscal year ending June 30, 1892, were $618,689.43, of which the sum of $152,225.60 was expended during the last year.

July 1, 1891, balance unexpended	$193,146.17
June 30, 1892, amount expended during fiscal year	148,182.45
July 1, 1892, balance unexpended	44,963.72
July 1, 1892, outstanding liabilities	4,043.15
July 1, 1892, balance available	40,920.57
Amount appropriated by act approved July 13, 1892	60,000.00
Amount available for fiscal year ending June 30, 1893	100,920.57
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	550,008.89

(See Appendix E E 1.)

2. *Indiana Chute, Falls of the Ohio.*—The Indiana Chute is the main river channel over the Falls of the Ohio; originally it was very crooked,

filled with dangerous, rocky projections from sides and bottom, and with swift changing currents. It was safely navigable by skilled pilots only when the river was above a stage of about 11 feet on the canal gauge. Prior to 1890 some of the most dangerous projections had been removed, but in that year a project for the radical improvement of the chute was adopted; this project aims to secure a channel safely navigable for the largest tows, when the river is at, or above, a stage of 8 feet on the canal gauge. Work on this project was commenced last year, but operations were limited to a very short period during extreme low water.

The amount expended on the improvement of this chute, to June 30, 1892, was $137,480.37.

July 1, 1891, balance unexpended	$48,885.20
June 30, 1892, amount expended during fiscal year	21,361.44
July 1, 1892, balance unexpended	27,523.76
July 1, 1892, outstanding liabilities	14.63
July 1, 1892, balance available	27,509.13
Amount appropriated by act approved July 13, 1892	35,000.00
Amount available for fiscal year ending June 30, 1893	62,509.13
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	57,249.53

(See Appendix E E 2.)

3. *Operating and care of Louisville and Portland Canal, Kentucky.*—The canal was open to commerce throughout the past year, except on twenty-three days, when the locks could not be operated because of high water.

Traffic through the canal during the year comprised the passage of 6,027 boats, with 1,620,586 tons of freight, 1,232,998 tons of which was coal.

Operations relating to the care of the canal comprised dredging about 100,000 cubic yards of mud, sand, and rock from the canal and its approaches; the completion of two new middle gates; the partial reconstruction of the machine shop, which had been destroyed by fire, and such repairs as were needed from time to time to the locks, bridges, boats, buildings, and machinery.

(See Appendix E E 3.)

4. *Wabash River, Indiana and Illinois.*—The improvement of this river has for some years past been carried on under two different appropriations, one of which was applicable only to that portion of the river below Vincennes, Ind., and the other above.

a. Below Vincennes.—The principal work in the project for this improvement has been the construction of a lock and dam to pass the Grand Rapids, near Mount Carmel, Ill. The lock was completed last year, as was also the abutment for the dam, the work done during the the year comprising 2,097 cubic yards of masonry laid, 3,074 cubic yards of earth and mud excavated, and 5,776 cubic yards of earth hauled and embanked behind lock walls and abutment of dam. Besides this work, the snag boat removed from this section of the river 429 snags, weighing 1,786 tons.

After the dam near Mount Carmel is completed, the improvement of this section of the river calls for the excavation of channels through shoals, and the construction of dams to properly concentrate the low-water flow. This will put the river in fairly navigable condition at ordinary low-water stages.

The amount expended to June 30, 1892, on the improvements of this section was $293,524.08.

July 1, 1891, balance unexpended	$41,800.77
June 30, 1892, amount expended during fiscal year	34,886.36
July 1, 1892, balance unexpended	6,914.41
July 1, 1892, outstanding liabilities	434.68
July 1, 1892, balance available	6,479.73
Amount appropriated by act approved July 13, 1892	60,000.00
Amount available for fiscal year ending June 30, 1893	66,479.73
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	40,000.00

b. Above Vincennes.—The work of improving this portion of the river is precisely similar in character to that contemplated on the lower section, after the completion of the lock and dam at Mount Carmel; channels must be excavated through shoals, the low-water flow concentrated by dams or dikes, and the river cleared of snags. At present the river is navigable for very light-draft only, at ordinary low water, and the channels are badly obstructed by snags. No work was done on this section during the past year, because the United States had no snagging outfit available, and no satisfactory arrangements could be made with private parties for doing the work. Material for rebuilding the old snag boat was procured, and the work thereon commenced toward the close of the year.

The completion of the lock and dam at Mount Carmel will establish free communication between the upper and lower sections of the river.

The amount expended on this section above Vincennes to June 30, 1892, was $72,172.02.

July 1, 1891, balance unexpended	$5,742.26
June 30, 1892, amount expended during fiscal year	974.28
July 1, 1892, balance unexpended	4,767.98
July 1, 1892, outstanding liabilities	440.00
July 1, 1892, balance available	4,327.98
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	9,327.98
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	15,000.00

(See Appendix E E 4.)

5. *White River, Indiana.*—The river is badly obstructed by shoals and snags, and without a very considerable expenditure it is not practicable to make it available for navigation except at high and medium stages of water. Channels might be excavated through some of the worst shoals, but no material increase in navigation would thereby result. If all the snags which obstruct existing channels are cleared out, the present commercial interests on this stream will be fairly accommodated.

During the past year operations were limited to improving the channel through Kellys Ripple by constructing a guiding dike 350 feet long from the south channel dike to the adjoining river bank.

The amount expended on this river to June 30, 1892, was $104,549.96.

July 1, 1891, balance unexpended	$5,175.32
June 30, 1892, amount expended during fiscal year	2,220.53
July 1, 1892, balance unexpended	2,954.79
July 1, 1892, outstanding liabilities	4.75
July 1, 1892, balance available	2,950.04
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	7,950.04
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	7,500.00

(See Appendix E E 5.)

IMPROVEMENT OF GREAT KANAWHA, ELK, AND GAULEY RIVERS, WEST VIRGINIA, AND OF NEW RIVER, VIRGINIA AND WEST VIRGINIA.

Officer in charge, Col. William P. Craighill, Corps of Engineers.

1. *Great Kanawha River, West Virginia.*—This river flows through a fertile and picturesque region, filled with mineral wealth, especially coal and salt. It is by nature divided into a number of pools, some of considerable length and depth, separated by shoals of gravel and coarse sand, which were the principal obstructions to navigation in low water, there being often on them at such seasons but a few inches of water. In some of the pools were found shallow places, also obstructing navigation. There were also snags and loose rocks in the channel. The navigation was almost suspended in summer.

The coal and salt were generally sent out on rises, which enabled the boats to pass safely over the obstructions that otherwise would stop their movements entirely. The use of the river for the movement of these valuable products was therefore unsatisfactory and intermittent. By the agency and superintendence of a board acting under the State, first of Virginia and then of West Virginia, considerable improvement in the river was from time to time effected, tolls being charged on the commerce for the payment of expenses.

The object of the improvement, begun several years ago by the United States, was to give a constant navigable depth of at least 6 feet throughout the whole length of the Kanawha to its mouth at the Ohio River, to be accomplished by large locks and dams.

Those already built have been about 300 by 50 feet above Charleston and about 340 by 55 below.

The peculiarity of most of the dams is that they can be lowered when the stage of the water in the river will suffice over the shoals. This gives them the name of "movable dams," and enables an open river to be had when the water is high enough.

Dams 3 and 2, above Paint Creek, are fixed, as the declivity of the river in that section is too great to permit the advantageous use of the movable system.

Up to June 30, 1891, the amount expended was $2,182,670.65. At that date the finished works were Locks and Dams 2, 3, 4, 5, and 6.

An appropriation of $300,000 was made September 19, 1890.

The following list of contracts indicates in a summary manner the principal work in progress during the fiscal year:

Contract dated November 26, 1888, with Carkin, Stickney & Cram, for building Lock No. 7, completed in February, 1892.

Contract with C. Irwin McDonald, dated August 20, 1889, for building Lock No. 8, completed in February, 1892.

Contract with Munford & Reynolds, dated December 29, 1890, for the foundations of Dam No. 7, or immovable parts of the navigation pass and weir, and of a central pier and an abutment with shore crib and bank protection, to be completed December 31, 1892.

Contract with C. Irwin McDonald, dated March 3, 1891, for the foundations of Dam No. 8, or immovable parts of the navigation pass and weir, and of a central pier and an abutment with shore crib and bank protection, to be completed December 31, 1892.

The amount expended in the year ending June 30, 1892, exclusive of outstanding liabilities, was $206,631.38.

Had funds been available, all the locks and dams needed for this improvement could have been begun at the same time and finished in three years with much economy to the United States and with manifest advantage in the use of the improved waterway. The development of commerce on this river has been very great since the improvement by the United States, although the project has as yet been only partially executed for want of money.

During the seasons of low water the value of the improvement is shown in a very marked manner, as free and sufficient navigation is then easily maintained over the improved part of the river, while navigation may be entirely suspended below the lowest dam and above the upper pool.

The estimate for the project for the improvement of the Great Kanawha River by the method of locks and movable dams was prepared in 1875, seventeen years ago. As the work is now approaching completion it seemed to be expedient to revise the estimate, which will be found in a special report of the officer in charge in Appendix F F 1.

July 1, 1891, balanced unexpended		$414,531.40
June 30, 1892, amount expended during fiscal year		206,631.38
July 1, 1892, balance unexpended		207,900.02
July 1, 1892, outstanding liabilities	$4,000.00	
July 1, 1892, amount covered by uncompleted contracts	181,469.21	
		185,469.21
July 1, 1892, balance available		22,430.81
Amount appropriated by act approved July 13, 1892		225,000.00
Amount available for fiscal year ending June 30, 1893		247,430.81
Amount (estimated) required for completion of existing project		1,080,700.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix F F 1.)

2. *Operating and care of locks and dams on Great Kanawha River, West Virginia.*—The amount of expenses during the fiscal year ending June 30, 1892, has been $22,003.96.

(See Appendix F F 2.)

3. *Elk River, West Virginia.*—The Elk is one of the chief tributaries of the Great Kanawha. Its course is tortuous, but the country through which it flows is rich in minerals and well fitted for agriculture and grazing.

The average low-water width is about 200 feet, with narrows at the rapids of about 150 feet in width and occasional portions of about 300 feet in width. The pools vary in depth from 3 to 10 feet, and are separated by rapids over shoals of cobblestones and gravel, on which there has been at low seasons a depth of but a few inches of water. The average fall per mile in the river from Braxton down is about 2½ feet, but is not uniformly distributed, being greatest (about 4 feet per mile) in the central section and less (about 2 feet) in the upper and lower sections. Freshets of small height are of frequent occurrence, but rapidly pass off. The annual rise in the spring is about 10 or 12 feet. An extraordinary rise is sometimes had of 25 to 30 feet, but the duration is not great.

The approved project of improvement has been the removal of rocks, snags, overhanging trees, etc., and the cutting of narrow sluices through the rapids and shoals. The principal interests to be served are those of lumbering and rafting, but much country produce is also carried down stream in small boats, which return with merchandise, etc.

A few days were spent in July, 1891, in removing snags near the mouth of the river; and in September and October the small balance available was expended in blasting a channel for logs through the large, loose rocks in the shoals in the upper river near Webster, in building, repairing, and altering chute walls and dikes, and in removing rocks between Clay and the mouth of the river.

A serious obstruction to the navigation of this river at some stages consists of several milldams. The attention of the proper authorities has been called to these in compliance with the law.

July 1, 1891, balance unexpended	$2,754.31
June 30, 1892, amount expended during fiscal year	2,595.42
July 1, 1892, balance unexpended	158.89
Amount appropriated by act approved July 13, 1892	2,500.00
Amount available for fiscal year ending June 30, 1893	2,658.89

(See Appendix F F 3.)

4. *Gauley River, West Virginia.*—Gauley River takes its rise in Webster County, W. Va., its tributaries having their sources in Pocahontas County and Greenbrier County. It is about 115 miles in length, flowing through Nicholas and Fayette counties in a southwesterly direction, sometimes nearly west, and near its mouth almost due south; it is entirely in the State of West Virginia. Its head waters and those of its tributaries are covered with a virgin forest of the finest timber, with only clearings of a few acres here and there; and on the north side of the river, in Webster and Nicholas counties, some glades a few miles wide and in extent 20 or 25 miles, which give only a stunted growth, to break up this vast timber section.

For the first 12 miles from its mouth the Gauley falls only 4 feet per mile; in the next 26 miles its fall is nearly 34 feet per mile, in a gorge similar to that of New River, as seen from the Chesapeake and Ohio Railway between Kanawha Falls and Hinton, the hills on either side being several hundred feet high and almost perpendicular, and the stream full of bowlders of sandstone, some very large, and so numerous as to justify the people in calling this section the "Roughs" of Gauley. From the head of the "Roughs," near Hominy Creek, 2 miles above Hughes Ferry, to the Forks, about 57 miles, the fall is estimated at 5 feet per mile. The levels from the mouth of Gauley River to the mouth of Meadow River, 29 miles, are taken from Ellet's report on the Great Kanawha River, West Virginia, made in 1858; the remainder are estimated. The levels on Meadow River were obtained from the same source.

Gauley River is 500 feet wide at its mouth, 350 feet wide at mouth of

Meadow River, 200 feet wide at mouth of Cranberry River, 150 feet wide at mouth of Williams River, and 75 feet wide at the Forks.

Operations for the improvement of the Gauley River were instituted after an examination made in 1878 in accordance with the provisions of the river and harbor act of August 5, 1886. It was then pointed out that a valuable improvement of the 12 miles of river from the mouth to the "Roughs" could be made at an expense of $10,000, and that a great advantage would follow the expenditure of $65,000 in the 26-mile reach called the "Roughs" in facilitating and cheapening the bringing to market of millions of feet of lumber of the most valuable and varied kinds.

The approved project has consisted in the removal of ledges and loose rocks and the making of channels through shoals of loose rock and bowlders from the mouth of the river to the "Roughs" to improve the navigation for boats and rafts, and in blasting down the very large bowlders in the "Rough" to permit the more free passage of logs. The amount expended to the close of the fiscal year ending June 30, 1891, was $2,881.04, with decided advantage to the navigation over the worst shoals below the "Roughs."

The amount expended in the fiscal year ending June 30, 1892, has been $2,856.28, with which the channels below the "Roughs" have been improved in width and position, and a good beginning has been made on the formidable "Roughs" themselves.

In the money statement in the last Annual Report under the head of Gauley River, West Virginia, the following is found, "Amount (estimated) required for completion of existing project, $4,000."

The project under which Congress has given two appropriations contained two heads, namely, the improvement from the mouth of the river to the "Roughs" for bateaux navigation, $10,000, and for the improvement of the "Roughs" and above them, $65,000, total $75,000; see Annual Report for 1888, Part III, Page 1762. The appropriations up to this time have been those of August 11, 1888, September 19, 1890, and July 13, 1892, each $3,000, amounting to $9,000.

Work was first begun on the portion below the "Roughs," of which the cost was estimated to be $10,000, and when $4,000 was stated a year ago to be the balance estimated for completion of existing project, it was understood to refer to that portion of the river. The statement should have read "Amount (estimated) required for completion of existing project below the "Roughs," $4,000."

It is proposed by the Kanawha and Michigan Railroad Company to erect a bridge over this river near the mouth; but the plan has not been fully determined upon at the close of the fiscal year.

July 1, 1891, balance unexpended	$2,938.96
June 30, 1892, amount expended during fiscal year	2,856.28
July 1, 1892, balance unexpended	82.68
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	3,082.68
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	66,000.00

(See Appendix F F 4.)

5. *New River, Virginia and West Virginia.*—The last appropriation was that of August 5, 1886, of which a balance remains of $2,341.79.

In compliance with a recommendation of the local engineer, it was decided by the Secretary of War not to expend the existing balance at present.

There were no operations or expenditures in the year ending June 30, 1892.

It is proposed by the Chesapeake and Ohio Railroad to construct a bridge over the unnavigable portion of this river not far above its junction with the Gauley.

July 1, 1891, balance unexpended	$2,341.79
July 1, 1892, balance unexpended	2,341.79
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	159,000.00

(See Appendix F F 5.)

IMPROVEMENT OF CERTAIN RIVERS IN KENTUCKY AND WEST VIRGINIA.

Officer in charge, Maj. D. W. Lockwood, Corps of Engineers, with Lieut. W. L. Sibert, Corps of Engineers, under his immediate orders; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Tradewater River, Kentucky.*—This river was practically closed before the work of improvement commenced by a rock bar near its mouth, and higher up by logs, snags, drift piles, leaning trees, and bars.

The present project, adopted in 1881, provides for clearing the river and its banks of obstructions, and opening up a channel 40 feet wide and 2½ feet deep during six months of the year, the improvement to extend 41 miles up-stream from its mouth in the Ohio.

Up to June 30, 1891, $15,481.46 had been expended, resulting in securing a channel through the rock bar near the mouth of the river, and in removing obstructions in the channel and on the banks of the river for a distance of 41 miles, the distance covered by the present project.

During the fiscal year ending June 30, 1892, no field work was done, the amount expended, $111.44, being for care of property and incidentals.

July 1, 1891, balance unexpended	$1,018.54
June 30, 1892, amount expended during fiscal year	111.44
July 1, 1892, balance unexpended	907.10

(See Appendix G G 1.)

2. *Operating and keeping in repair locks and dams on Green and Barren rivers, Kentucky.*—When the United States acquired possession of these improvements, December 11, 1888, navigation of the system was broken at lock No. 3, Green River, the river wall of that lock having fallen into the river, the lower end of the land wall of No. 1, Barren, was badly cracked and liable to fall at any time, and both walls of No. 2, Green River, were in a dangerous condition. The channel of the river was much obstructed by snags and slides.

Up to June 30, 1891, $344,251.73 had been expended, resulting in the removal of the old river wall at lock No. 3; the construction of a cofferdam inclosing the site of the new wall and in the rebuilding of the wall and reopening the lock to navigation; the taking down and reconstruction of the lower half of the river wall at No. 1, Barren; the rebuilding of dams No. 1, Barren, and No. 3, Green, from the crest to foot of lower slope; the raising of lock walls at No. 1, Green, and in grading and paving behind the land wall at No. 1, Barren, and in rear of both walls at No. 1, Green, and the building of seven lock-keepers' houses.

A large number of snags, etc., were removed by the snag boat *Wm. Preston Dixon.*

During the fiscal year ending June 30, 1892, $75,686.26 was expended and resulted in general repairs to locks and dams; grading and paving lock grounds; construction of guide and protection cribs; removal of snags, and dredging of lock entrances. Navigation has been practically continuous throughout the year.

The estimate of the cost of operating and care, etc., for fiscal year ending June 30, 1893, is $56,139.

(See Appendix G G 2.)

3. Rough River, Kentucky.—This river is very much obstructed by overhanging trees on the banks, and by snags, logs, etc., in the bed of the river. The lower 8 miles of the stream are affected by backwater from the Rumsey dam (No. 2), on Green River, but above this the stream has but little depth at low water.

The project for the improvement adopted in 1890 is to clear the river of obstructions, to wit, overhanging trees on the banks, and snags, logs, and stumps in the bed of the river, and to locate and construct a lock and dam near the site of the old ones to carry slackwater to Hartford.

The amount of money expended to June 30, 1891, was $708.54, and resulted in the survey for the site of lock, dam, and lands, preparing plans for the lock, dam, etc., in the construction of a quarter boat for working party, and the deadening of trees and removal of obstructions over 2½ miles of the lower river.

The amount expended during the fiscal year ending June 30, 1892, was $5,123.50, and resulted in deadening the timber on the banks of the river to Hartford, and clearing the bed of the river of snags, sunken timber, and logs up to the same point.

July 1, 1891, balance unexpended	$24,291.46
June 30, 1892, amount expended during fiscal year	5,123.50
July 1, 1892, balance unexpended	19,167.96
Amount appropriated by act approved July 13, 1892	15,000.00
Amount available for fiscal year ending June 30, 1893	34,167.96
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	65,556.05

(See Appendix G G 3.)

4. Kentucky River, Kentucky.—The condition of the river when the United States assumed charge of its improvements was as follows: The five locks and dams with their approaches, built by the State of Kentucky, were in a dilapidated condition, and the channel was much obstructed by snags and leaning trees.

The project for the improvement, adopted in 1879, called for the necessary repairs to the five locks and dams and the extension of slackwater navigation for a draft of 6 feet, by the construction of additional locks and dams to Beattyville, a distance of 261 miles from the mouth of the river.

Up to the close of the fiscal year ending June 30, 1891, $1,196,183.41 had been expended, resulting in restoring the locks and dams to a navigable condition, clearing the channel and banks of obstructions, and the commencement of a lock.

The amount expended during the fiscal year ending June 30, 1892, was $147,834.43, and resulted in the building of Lock and Dam No. 6, near Oregon, and the extension of slackwater navigation to High Bridge, a distance of 22 miles; in the removal of the Brooklyn rocks from Pool No. 6, and the completion of a low dam at Beattyville, to give low-water navigation to the mouth of Middle Fork, the nearest point of the Kentucky Union Railroad to Beattyville.

July 1, 1891, balance unexpended	$151,816.59
June 30, 1892, amount expended during fiscal year	147,834.43
July 1, 1892, balance unexpended	3,982.16
July 1, 1892, outstanding liabilities	2,128.03
July 1, 1892, balance available	1,854.13
Amount appropriated by act approved July 13, 1892	150,000.00
Amount available for fiscal year ending June 30, 1893	151,854.13
Amount (estimated) required for completion of existing project	1,524,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix G G 4.)

5. *Operating and keeping in repair locks and dams on Kentucky River, Kentucky.*—The first allotment for this work was for the fiscal year ending June 30, 1885, at which time only four locks could be operated; these required extensive repairs at the time, and the dams and approaches were in a more or less dilapidated condition.

The amount expended to June 30, 1891, was $335,765.89, and resulted in reopening Lock No. 5 to navigation, and placing the other locks and dams in a serviceable condition, the building of guide walls and approaches, the construction of one double and seven single lock houses, and in grading, paving, and draining grounds about the locks. A new dredge boat, of the Osgood pattern, and two dump scows have been constructed, and general repairs made to locks, dams, etc., and in addition the river has been kept clear of snags.

A stone abutment to Dam No. 2 has been constructed and the lock entrances kept clear by dredging.

The amount expended during the fiscal year ending June 30, 1892, was $48,999.40, and resulted in general repairs to locks and dams, removing snags, and keeping entrances clear by dredging.

The estimate of the cost of operating and care for the fiscal year ending June 30, 1893, is $42,769.52.

(See Appendix G G 5.)

6. *Licking River, Kentucky, between Farmers and West Liberty.*—This stream was originally much obstructed by logs, snags, rocks, and leaning trees, as well as by fish dams constructed by private parties.

The project for the improvement was adopted in 1888, and provides for removing the rocks, snags, and bowlders from the river bed.

The amount expended to June 30, 1891, was $4,468.86, and resulted in the removal from the bed of the river of a large number of rocks, snags, etc., that obstructed both rafting and low-water navigation.

The amount expended during the fiscal year ending June 30, 1892, was $1,827.23 and resulted in the further improvement of rafting and low-water navigation by removal of obstructions from the bed and banks of the river.

July 1, 1891, balance unexpended	$2,034.67
June 30, 1892, amount expended during fiscal year	1,827.23
July 1, 1892, balance unexpended	207.44
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	11,680,00

(See Appendix G G 6.)

7. *Big Sandy River, West Virginia and Kentucky.*—When the United States commenced improving this stream it and its forks were much obstructed by rocks, bars, snags, and leaning trees. During the low-water season navigation was practically suspended.

The present project was adopted in 1878, and provided for improving the push-boat and rafting facilities of the river and forks by removing obstructions, etc. This was modified in 1880 to secure slackwater navigation by the construction of a test lock and dam near Louisa, Ky.

The amount expended to June 30, 1891, was $230,265.85, and resulted in improving low-water navigation by the removal of rocks, snags, stumps, and logs from the channel and leaning trees from the banks of the river, and in the construction of a lock complete, near Louisa, together with the abutment for a dam. Also, in the construction of about 80 feet of a permanent dam and the purchase of timber for the completion of same, filling in behind abutment, and deepening approaches to lock.

The amount expended during the fiscal year ending June 30, 1892, was $13,626.28, and resulted in taking care of Government property, surveys, discharge measurements, and investigations with regard to the construction of a needle dam to take the place of the fixed dam formerly projected.

July 1, 1891, balance unexpended	$29,734.15
June 30, 1892, amount expended during fiscal year	13,626.28
July 1, 1892, balance unexpended	16,107.87
July 1, 1892, outstanding liabilities	764.73
July 1, 1892, balance available	15,343.14
Amount appropriated by act approved July 13, 1892	50,000.00
Amount available for fiscal year ending June 30, 1893	65,343.14
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	28,029.25

(See Appendix G G 7.)

8. *Levisa Fork of Big Sandy River, Kentucky.*—This stream was originally much obstructed by rocks, snags, logs, and overhanging trees. Its improvement has been in progress since work on the Big Sandy was commenced under the project for the improvement of that stream.

The present project was adopted in 1890, and provides for the removal of snags, logs, stumps, rocks, etc., from the river and overhanging trees on the banks.

The amount expended to June 30, 1891, was $19,598.24, and resulted in the material improvement of navigation; push boats at low water and rafting and light-draft steamboat navigation at moderate stages.

The amount expended during the fiscal year ending June 30, 1892, was $1,131.90, and resulted in the removal of snags, rocks, logs, and stumps from the river bed.

July 1, 1891, balance unexpended	$1,151.76
June 30, 1892, amount expended during fiscal year	1,131.90
July 1, 1892, balance unexpended	19.86
Amount appropriated by act approved July 13, 1892	2,500.00
Amount available for fiscal year ending June 30, 1893	2,519.86

(See Appendix G G 8.)

9. *Tug Fork of Big Sandy River, West Virginia and Kentucky.*—This stream was originally much obstructed by rocks, snags, logs, and overhanging trees. Its improvement has been in progress since work on the Big Sandy was commenced on the project for the improvement of that stream.

The present project was adopted in 1890, and provides for the removal of snags, logs, stumps, rocks, etc., from the river and overhanging trees on the banks.

The amount expended to June 30, 1891, was $19,328.33, and has resulted in the material improvement of navigation; push boats at low water and rafting and light-draft steamboat navigation at moderate stages.

The improvement has been carried to a point 100 miles above Louisa.

The amount expended to June 30, 1892, was $1,270.33, and resulted in the general improvement of the lower portion of the river. The upper 22 miles, improved, has been very much obstructed in recent years by the construction of the Norfolk and Western Railroad, rocks, stumps, and trees having been blasted and thrown into the stream in preparing the road bed for that road.

July 1, 1891, balance unexpended	$1,421.67
June 30, 1892, amount expended during fiscal year	1,270.33
July 1, 1892, balance unexpended	151.34
July 1, 1892, outstanding liabilities	40.55
July 1, 1892, balance available	110.79
Amount appropriated by act approved July 13, 1892	2,500.00
Amount available for fiscal year ending June 30, 1893	2,610.79

(See Appendix G G 9.)

10. *Guyandotte River, West Virginia.*—This stream was originally much obstructed by snags, logs, leaning trees, the remains of old dams, and milldams owned by private parties, which required removal.

The project for the improvement was adopted in 1878, and provided for the removal of existing obstructions, natural and artificial, so as to form a channel 30 feet wide, with a least depth of 18 inches, during five months of the year, and extending up the river a distance of 122 miles from the Ohio.

Up to the close of the fiscal year ending June 30, 1891, $15,103 had been expended, resulting in the partial improvement of the river for a distance of 119 miles, removing snags, logs, etc., from the channel, and cutting passage ways through old dams.

During the fiscal year ending June 30, 1892, $1,303.30 was expended, and resulted in the general improvement of the stream for rafting purposes from Big Huff Creek to Barboursville.

July 1, 1891, balance unexpended	$1,397.00
June 30, 1892, amount expended during fiscal year	1,303.30
July 1, 1892, balance unexpended	93.70
July 1, 1892, outstanding liabilities	.25
July 1, 1892, balance available	93.45
Amount appropriated by act approved July 13, 1892	2,000.00
Amount available for fiscal year ending June 30, 1893	2,093.45

(See Appendix G G 10.)

11. Little Kanawha River, West Virginia.—This river, at the time improvements were commenced by the United States, was much obstructed by logs, snags, leaning trees, etc., above that portion controlled by the Little Kanawha Navigation Company.

The original project, adopted in 1876, was for the removal of Beaver and Nailor Bend rocks, and for cleaning out snags and fallen trees. This was modified in 1880 by the adoption of an additional project for the construction of a lock and dam 2 miles above Burning Springs, W. Va.

Up to June 30, 1891, $183,859.71 had been expended, resulting in placing the upper part of the river in a fair rafting condition, and so that during moderate stages light-draft steamboats could run as far as Grantsville. The masonry of the lock was completed, a lock house built, and the abutment and 65 feet of the dam put in. The space behind the land wall of the lock was filled in.

During the fiscal year ending June 30, 1892, $23,805.89 was expended, and resulted in the completion of the dam, except backing, constructing the gates, and putting them and valves and operating machinery in place.

The area behind the land wall was partly paved, and cribs at upper and lower ends of land wall partially constructed.

July 1, 1891, balance unexpended	$27,315.29
June 30, 1892, amount expended during fiscal year	23,805.89
July 1, 1892, balance unexpended	3,509.40
July 1, 1892, outstanding liabilities	986.05
July 1, 1892, balance available	2,523.35

(See Appendix G G 11.)

12. Operating and keeping in repair the lock and dam on Little Kanawha River, West Virginia.—The lock was open to navigation December 2, 1891, and has been operated continuously, with the exception of a short time in June, when it was closed temporarily for repairs.

The amount expended for the fiscal year ending June 30, 1892, was $706.65, in operating the lock and making general repairs to lock and dam, etc.

The estimate of the cost of operating and care for the fiscal year ending June 30, 1893, is $5,220.

(See Appendix G G 12.)

13. Buckhannon River, West Virginia.—This stream was originally so obstructed by rocks and log jams that timber could be floated out only on a 12-foot rise.

The project for its improvement, adopted in 1884, provides for the formation of a rafting channel 24½ miles long, with a minimum width of 30 feet.

The amount expended to June 30, 1891, was $4,472.60, and resulted in clearing out some of the worst rocks and log jams.

The amount expended during the fiscal year ending June 30, 1892, was $1,010.18, and resulted in the removal of 3,510 cubic yards of rock, 136 trees, and 25 logs.

July 1, 1891, balance unexpended	$1,027.40
June 30, 1892, amount expended during fiscal year	1,010.18
July 1, 1892, balance unexpended	17.22

(See Appendix G G 13.)

LAKE HARBORS AND RIVERS.

IMPROVEMENT OF HARBORS ON LAKE SUPERIOR.

Officer in charge, Capt. W. L. Fisk, Corps of Engineers; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Harbor at Grand Marais, Minnesota.*—This small natural basin was not originally of sufficient depth nor was it adequately sheltered either for commercial purposes or for use as a harbor of refuge; the approved project of 1879 therefore proposed two breakwater piers each 350 feet long from the east and west points of the bay, or one pier 700 feet long from the east point, and the dredging to a depth of at least 16 feet of an anchorage area of about 26 acres at a total estimated cost of $139,669.40. Up to the close of the fiscal year ending June 30, 1891, there had been expended on this work $94,461.15; with this sum 350 feet of the east pier had been completed and the 16-foot anchorage area increased to 15.1 acres.

During the fiscal year ending June 30, 1892, there was expended $21,455.89, all for dredging, and the 16-foot anchorage area is now 21.5 acres in extent.

July 1, 1891, balance unexpended	$22,922.18
June 30, 1892, amount expended during fiscal year	21,455.89
July 1, 1892, balance unexpended	1,466.29
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year June 30, 1893	11,466.29
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	12,319.40

(See Appendix H H 1.)

2. *Harbor at Agate Bay, Minnesota.*—This is a shipping port for iron ore, and when the breakwater piers are built will form a harbor of refuge. It is 27 miles east of Duluth.

The project for the improvement of this harbor was adopted in 1887, and contemplates the erection of two piers projecting from the headlands of the bay and inclosing about 109 acres of water area. The eastern pier is to be 1,000 feet long and the western one 900 feet. Work upon the east pier was commenced in 1887 and at the close of work in November last 750 feet of it had been built.

The beneficial effects of the work done are greater than were anticipated, the tranquillity of the harbor has been greatly augmented, and vessels are no longer obliged to put to sea during storms, but can find safety under the shelter of the breakwater.

Amount expended to June 30, 1891, $36,255.79; amount expended during fiscal year ending June 30, 1892, $25,128.80.

July 1, 1891, balance unexpended	$26,244.21
June 30, 1892, amount expended during fiscal year	25,128.80
July 1, 1892, balance unexpended	1,115.41
Amount appropriated by act approved July 13, 1892	30,000.00
Amount available for fiscal year ending June 30, 1893	31,115.41
Amount (estimated) required for completion of existing project	151,708.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix H H 2.)

3. *Harbor at Duluth, Minnesota.*—The original project for the improvement of the harbor, adopted in 1871, consisted of a breakwater in Lake Superior, outside of Minnesota Point, in continuation of one already commenced by the Northern Pacific Railroad Company. This breakwater was destroyed by a storm in 1872 and abandoned. In 1873 Congress provided for maintaining the canal through Minnesota Point, which had been constructed by the city of Duluth, and for dredging channels in Superior Bay to the Duluth docks.

Work under this project was continued until 1881, at which time the piers of the canal had been repaired and somewhat extended, a harbor basin dredged of moderate capacity, and a narrow channel dredged in Superior Bay from Duluth to deep water at Connor Point. The amount expended under this project was $270,651.81.

The present project was adopted in 1881 and modified in 1884, and 1888, the object being to preserve the piers bordering the canal, dredging an inner harbor to accommodate vessels drawing 16 feet of water, a channel parallel with the Park Point dock line 100 feet wide, a channel east of Rice Point 200 feet wide and 17 feet deep, and a channel along the north shore of St. Louis Bay 200 feet wide, 17 feet deep.

The total amount expended on the harbor to June 30, 1891, is $590,732.98, of which $270,651.81 was expended prior to the adoption of the present project; the amount expended under the present project to the same date is $320,081.17. The work has resulted in increasing the dredged area of the harbor basin to about 104 acres, exclusive of private dredging, removing shoals from area previously dredged, giving the whole dredged basin a minimum depth of 16 feet, deepening the Blast Furnace Channel to a like depth, maintaining the canal piers, and commencement of channels east of Rice Point and on north shore of St. Louis Bay. The Blast Furnace Channel was abandoned upon the establishment of the new dock lines.

Work during the past year consisted in enlarging the new channel on the north side of St. Louis Bay. The season's work gave this channel a width of about 100 feet between 15-foot curves. The amount of material dredged was 295,177.3 cubic yards.

The canal piers are in a poor condition, and the entire work needs to be replaced with an improved and permanent structure.

The harbor basin and connecting channels will eventually require deepening to 22 feet. The channels recently commenced should be completed at an early date, both for the accommodation of commerce and as a matter of economy. The ruling depths in the portions of the harbor dredged by the United States are—

	Feet.
In canal	17
In the inner basin or harbor	16
In channel on north shore of St. Louis Bay for a distance of about 12,900 feet	16
In new channel east of Rice Point	16

July 1, 1891, balance unexpended		$62,833.73
June 30, 1892, amount expended during fiscal year		45,822.98
July 1, 1892, balance unexpended		17,010.75
July 1, 1892, outstanding liabilities	$62.23	
July 1, 1892, amount covered by uncompleted contracts	10,240.00	
		10,302.23
July 1, 1892, balance available		6,708.52
Amount appropriated by act approved July 13, 1892		125,000.00
Amount available for fiscal year ending June 30, 1893		131,708.52
Amount (estimated) required for completion of existing project		122,026.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix H H 3.)

4. *Harbor at Superior Bay and St. Louis Bay, Wisconsin.*—Originally the natural entry to Superior Bay was obstructed with shifting bars having at most but 9 feet depth of water over them. The citizens of Superior attempted to remedy this by constructing piers to confine the outflowing waters of the bay, and this work was taken up by the United States in 1867, and has successfully maintained since then a ruling depth of 16 feet between the piers.

The piers are 350 feet apart, and a good deal of dredging has been necessary to obtain the required depth between them and the channels leading to Connor Point and the Quebec Dock and a new connecting channel in St. Louis Bay. The original project of 1867 has, therefore, been modified from time to time to meet the needs of the rapidly increasing capacity of the vessels visiting this port, the last modification being made by act of Congress approved August 5, 1886, which added improvement of channel in St. Louis Bay.

In carrying out the original project with modifications there had been expended to June 30, 1891, the sum of $182,455.43.

Operations during the past year have consisted in widening and straightening the channel leading from the entry to Connor Point, widening the West Superior Channel in St. Louis Bay in the vicinity of Connor Point and the Northern Pacific Railroad Bridge, and extending it about 2,500 feet towards the natural deep water at Grassy Point.

The entry piers need extensive repairs, particularly the superstructure. The entry and dredged channels have full 16 feet depth.

July 1, 1891, balance unexpended	$71,674.65
June 30, 1892, amount expended during fiscal year	50,131.71
July 1, 1892, balance unexpended	21,542.94
Amount appropriated by act approved July 13, 1892	70,000.00
Amount available for fiscal year ending June 30, 1893	91,542.94
Amount (estimated) required for completion of existing project	156,736.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix H H 4.)

5. *Minnesota Point at Superior, Wisconsin.*—The object of this work is to protect the channel from the old entrance to Superior Bay from drifting sand and to prevent the lake from cutting through Minnesota Point into the bay at a low place known as "The Opening."

The project approved October 23, 1890, was for a double post and board fence of a total length of 1,216 feet filled in with brush and stone to catch the sand.

The fence was completed May 27, 1891, and is accomplishing the purpose for which it was built.

July 1, 1891, balance unexpended	$368.41
June 30, 1892, amount expended during fiscal year	322.49
July 1, 1892, balance unexpended	45.92

(See Appendix H H 5.)

6. *Harbor at Ashland, Wisconsin.*—Ashland Harbor is located at the head of Chequamegon Bay, and originally had no protection from the waves which rolled into the bay or from the waves generated within the bay itself by storms.

The approved project is for the construction of a pile, slab, and rock breakwater, 8,000 feet long, northeast of the town, and for dredging a channel in front of the wharves of the city to accommodate vessels drawing 16 feet of water. During the season of 1889 a portion of the breakwater 4,650 feet in length was completed, but a severe storm in November the same year destroyed the outer 50 feet and the slab filling settled in some places. During last year 1,080 feet was added to the breakwater, making its present length 5,680 feet, the breach in Chequamegon Point was closed with a brush and stone dike, and the old part of the breakwater repaired.

No dredging has yet been done.

The amount expended during the year was $59,400.87.

The total amount expended under approved project to June 30, 1891, was 77,737.80.

The breakwater, though of insufficient length to give full protection to all the wharves of the city, has nevertheless had a marked influence in improving the tranquillity of the harbor.

July 1, 1891, balance unexpended	$64,762.20
June 30, 1892, amount expended during fiscal year	59,400.87
July 1, 1892, balance unexpended	5,361.33
Amount appropriated by act approved July 13, 1892	45,000.00
Amount available for fiscal year ending June 30, 1893	50,361.33
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	142,500.00

(See Appendix H H 6.)

7. *Harbor at Ontonagon, Michigan.*—The entrance to Ontonagon River, which forms the harbor, had but 7 feet depth in 1867, at which time the project for securing 12 feet depth by building parallel piers on either side of the mouth, extending to the 18-foot curve of depth in Lake Superior, and dredging a channel between the piers, was adopted.

The west pier has reached a length of 2,675 feet, and is very nearly out to the 18-foot curve of depth, as proposed. But this curve has advanced in the mean time, owing to the very considerable volume of sand carried into the lake by the river, and since it appears probable that the advance of the bar will keep pace with the extension of the piers, unless a very considerable extension is made at once, a consideration scarcely to be expected, it does not appear that economic considerations would justify any further extension of the piers at present. The east pier is 2,315 feet in length.

For a time it seems that better results will be secured after the piers are put in repair and the superstructures to outer cribs of west pier are finished by dredging across the bar after each spring freshet.

The channel between the piers has kept a depth of over 12 feet; a dredged channel through the bar and the remaining 150 feet of superstructure on the west pier were completed last season.

At the close of work the channel was left with 16 feet of water in it, but it is presumed the river will at least partially fill this up during this season's freshets.

The amount expended during the fiscal year just closed was $9,585.39.

The total cost of the improvement to June 30, 1891, was $302,730.76.

July 1, 1891, balance unexpended	$11,042.31
June 30, 1892, amount expended during fiscal year	9,585.39
July 1, 1892, balance unexpended	1,456.92
Amount appropriated by act approved July 13, 1892	20,000.00
Amount available for fiscal year ending June 30, 1893	21,456.92
Amount (estimated) required for completion of existing project	35,670.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix H H 7.)

8. *Eagle Harbor, Michigan.*—Previous to the improvement of Eagle Harbor the entrance was obstructed by a rocky reef, with 8½ feet of water over the shoalest part.

The project for the improvement of this harbor was adopted in 1866 and modified in 1868, 1874, and 1878. The plan as finally carried out consisted in blasting and dredging through the rocky ledge a channel 130 feet wide and 14 feet deep, and marking it with two guiding cribs, one on each side of the channel, and the removal of a number of bowlders.

The amount expended to the close of the fiscal year ending June 30, 1892, was $94,713.67, and has resulted in carrying out the above project, the work having been completed in 1879, and meeting the present demands of commerce.

No appropriation is asked for this harbor, as the funds available will probably be sufficient to keep the work in good order for several years longer.

July 1, 1891, balance unexpended	$2,486.33
June 30, 1892, amount expended during fiscal year	200.00
July 1, 1892, balance unexpended	2,286.33

(See Appendix H H 8.)

9. *Harbor at Marquette, Michigan.*—Originally this harbor afforded no protection to vessels from easterly or northeasterly storms, and in 1866 a project was approved for the construction of a breakwater composed of cribs filled with rock, and projecting from the shore into the bay a distance of 2,000 feet. This pier was finished practically as projected in 1875, but since its commencement extensive repairs have been made to the superstructure.

As the timber composing the superstructure has been in place far longer than supposed probable, it is essential that it be replaced by more durable material. A project for a concrete superstructure was approved in February, 1890. Its estimated cost is $232,936.71.

In the river and harbor act of August 11, 1888, provision
for the extension of the breakwater. There was finished 60 fe
work and 180 feet of riprap foundation. The contract in pr
date of last annual report extended the breakwater 240 feet
700 feet to be built to complete it.

The breakwater in its present condition gives much protecti
harbor.

The amount expended during the fiscal year ending June
was $29,798.60.

The total cost of the work to June 30, 1891, was $349,770.58

July 1, 1891, balance unexpended........................
June 30, 1892, amount expended during fiscal year..................

July 1, 1892, balance unexpended........................
July 1, 1892, outstanding liabilities ....

July 1, 1892, balance available..............................
Amount appropriated by act approved July 13, 1892 ....

Amount available for fiscal year ending June 30, 1893.................

Amount (estimated) required for completion of existing project.......
Submitted in compliance with requirements of sections 2 of river and
harbor acts of 1866 and 1867.

(See Appendix H H 9.)

10. Harbor of refuge at Grand Marais, Michigan.—Origi
entrance to this harbor was obstructed by a bar, having bu
feet depth of water upon it. The project for its improvement
in 1881, has for its object a deep and safe channel into the har
ing it a harbor of refuge. This object is to be attained by
parallel piers projecting into the lake, and dredging out a ch
tween them, connecting the deep water of the lake with th
harbor.

The proposed length of each pier was 1,800 feet. The west
now reached a length 1,406 feet, and the east pier 853 feet.

A channel 150 feet wide and 17 feet deep was dredged out
the piers, but had shoaled until it had but from 7 to 9 feet dep
work begun last season.

The total amount expended under approved project to June
was $180,880.80.

The amount expended during the year ending June 30,
$45,727.26.

The outer ends of the canal piers were repaired, new shore
spurs put in, the old shore ends remodeled, and a channel 175
and 17 feet deep dredged through between the piers.

July 1, 1891, balance unexpended ....
June 30, 1892, amount expended during fiscal year.....................

July 1, 1892, balance unexpended ....
July 1, 1892, outstanding liabilities ....

July 1, 1892, balance available ....
Amount appropriated by act approved July 13, 1892 ....

Amount available for fiscal year ending June 30, 1893...............

Amount (estimated) required for completion of existing project......
Submitted in compliance with requirements of sections 2 of river
and harbor acts of 1866 and 1867.

(See Appendix H H 10.)

EXAMINATION AND SURVEY, MADE IN COMPLIANCE WITH PROVISIONS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *the St. Louis River, Minnesota, from Grassy Point, in St. Louis Bay, to Fond du Lac, or the State line between Minnesota and Wisconsin*, was made by the local engineer in charge, Maj. James B. Quinn, Corps of Engineers, and report thereon submitted through Col. O. M. Poe, Corps of Engineers, Division Engineer, Northwest Division. It is the opinion of Maj. Quinn, and of the division engineer, based upon the facts and reasons given, that this locality is worthy of improvement. This opinion being concurred in by me, Maj. Quinn was charged with its survey, which has been completed and report thereon submitted by Capt. Fisk. The improvement proposed contemplates forming a channel, by dredging where necessary, 100 feet wide at bottom and 16 feet deep up to Fond du Lac, at an estimated cost of $113,000. The reports were transmitted to Congress and printed as House Ex. Doc. No. 58, Fifty-second Congress, first session. (See also Appendix H H 11.)

IMPROVEMENT OF PORTAGE LAKE AND LAKE SUPERIOR CANALS, ACROSS KEWEENAW POINT, MICHIGAN, OF HARBORS ON WESTERN SHORE OF LAKE MICHIGAN NORTH OF CHICAGO, ILLINOIS, AND OF FOX AND MENOMINEE RIVERS, WISCONSIN.

Officers in charge, Maj. Chas. E. L. B. Davis, Corps of Engineers, to January 20, 1892, and Maj. James F. Gregory, Corps of Engineers, since that date, with Lieut. H. E. Waterman, Corps of Engineers, under their immediate orders; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. Portage Lake and Lake Superior Canals, across Keweenaw Point, Michigan.—In accordance with the provisions of the river and harbor act of September 19, 1890, the United States purchased and assumed the charge and care of these canals on August 3, 1891.

The improvements consist of entrance piers at the harbor entrances on Lake Superior and Keweenaw Bay, canals and canal revetments, dredged cuts and channel-ways, lights and buoys. There are no locks. When the United States assumed charge the piers and revetments were (and are now) in a dilapidated condition, bars had formed at the harbor entrances, and many places in the channel-ways had shoals by deposition of material.

As the water way is intended for the use of all vessels that navigate Lake Superior, and is actually used by a large proportion of them, it is necessary that the depth and width of the channels shall at least be equal to that of the St. Marys Falls Canal, which now limits the maximum draft and dimensions of the largest vessels which run to Lake Superior.

In the act of Congress before referred to, for the purpose of preserving and continuing the use and navigation of said canals, $10,000 "for each of the present and the next fiscal year" was appropriated.

As the United States did not acquire title and assume charge of the canals until August, 1891, the former amount reverted to the Treasury. Therefore only $10,000 has been available to the close of the fiscal year ending June 30, 1892. Of this amount $9,833.65 was expended in dredging between and outside of the piers at the Lake Superior entrance last summer and this spring, removing 20,684 cubic yards of material. Soundings and examinations were made all along the water way; a break in the west pier, Lake Superior, was repaired, and the canals cared for and preserved as well as the limited amount of funds available would allow.

Harbor lines in Portage Lake, Houghton County, Michigan.—For about 7 miles of Portage Lake, in the vicinity of Houghton and Hancock, harbor lines were recommended by a Board of Engineers and approved by the War Department January 5, 1891. For this purpose and for purposes connected with them, the sum of $5,128.70 was made available by the river and harbor act of September 19, 1890.

Up to the end of the fiscal year ending June 30, 1892, $2,817.78 has been expended in making surveys and examinations and in contingencies connected with the harbor lines.

Portage Lake and Lake Superior Canals, across Keweenaw Point.

Amount appropriated by act of September 19, 1890	$10,000.00
June 30, 1892, amount expended during fiscal year	9,833.65
July 1, 1892, balance unexpended	166.35
July 1, 1892, outstanding liabilities	166.35
Amount appropriated by act approved July 13, 1892	$50,000.00
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	1,245,000.00

Harbor lines in Portage Lake.

Amount appropriated by act of September 19, 1890	$5,128.70
June 30, 1892, amount expended to end of fiscal year	2,817.78
July 1, 1892, balance unexpended	2,310.92

(See Appendix I I 1.)

2. *Manistique Harbor, Michigan.*—The natural channel of entrance to the mouth of the Manistique River was 7 feet deep. By private enterprise 3,000 feet of slab piers had been built at the mouth of the river, and a channel dredged to 10 feet before any appropriation had been made by the Government.

The project for the improvement of the harbor was adopted in 1880, and consisted in dredging between the piers built by the Chicago Lumbering Company, increasing the depth of the channel to 12 feet for a width of 150 feet.

By the acts of 1880 and 1881 the sum of $6,000 was appropriated for this harbor in order to dredge a channel between the private piers of the above-mentioned dimensions. Dredging was done to the amount of 11,780 cubic yards at a cost of $2,989.21, and work was then suspended in consequence of the refusal of the company controlling the harbor to rectify their pier lines when rebuilding the same.

Nothing has been done since work was suspended in 1881.

Soundings taken in May, 1892, show a navigable channel between the piers with a depth of 13 feet, but with a governing depth over the bar of about 11 feet.

July 1, 1891, balance unexpended	$2,600.76
June 30, 1892, amount expended during fiscal year	31.36
July 1, 1892, balance unexpended	2,569.40

(See Appendix I I 2.)

3. *Cedar River Harbor, Michigan.*—Previous to improvement the mouth of Cedar River was 175 feet wide and 8 to 10 feet deep, with a 3-foot bar in front.

Improvements had been made by private parties prior to the commencement of Government work.

The project of improvement was adopted in 1883, with a modification in the direction of the piers in 1884, the object being to afford an entrance channel of navigable width and 14 feet in depth.

Up to June 30, 1891, there had been expended $27,781.93, resulting in the construction of two pile piers 754 and 301 feet long, respectively, in continuation of the slab docks built by private enterprise, and a channel that in October, 1885, was 50 feet wide and 13 feet deep, and 100 feet wide for a depth of 11 feet.

Soundings taken in May, 1892, showed a channel 20 feet wide and 12 feet deep; also a channel 10 feet deep with a least width of 40 feet. Dredging by private enterprise was in progress.

Work was suspended in November, 1885, and has not been resumed by the United States since that date. It is reported that some dredging was done by private parties in 1891 and 1892.

July 1, 1891, balance unexpended	$2, 218. 07
June 30, 1892, amount expended during fiscal year	76. 00
July 1, 1892, balance unexpended	2, 142. 07
Amount (estimated) required for completion of existing project	108, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix I I 3.)

4. *Menominee Harbor, Michigan and Wisconsin.*—Previous to the improvement of this harbor the depth of water at the mouth of the Menominee River was about 4 feet, and the river was navigable for boats of that draft for some 2 miles above its mouth.

The project for the improvement of the harbor was adopted in 1871 and modified in 1874, the object being to afford a channel of entrance of navigable width and not less than 14 feet depth.

The amount expended up to June 30, 1891, was $208,776.54, resulting in the construction of two piers, 400 feet apart, the north pier 1,854 feet long and the south pier 2,710 feet long, with a dredged channel between, 14 feet deep and 200 to 300 feet wide.

During the fiscal year ending June 30, 1892, $2,876.73 was expended in dredging, which resulted in the formation of a channel 3,000 feet long, 200 feet wide, and 16 feet deep, from the 16-foot contour in Green Bay to the lower end of the channel of the Menominee River, of the same depth and width.

July 1, 1891, balance unexpended	$3, 255. 05
June 30, 1892, amount expended during fiscal year	2, 876. 73
July 1, 1892, balance unexpended	378. 32
Amount (estimated) required for repairs to piers	15, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix I I 4.)

5. *Menominee River, Michigan and Wisconsin.*—The river and harbor act of September 19, 1890, appropriated $54,000 for "continuing the improvement up the river from termination of old work" and the original approved project was for dredging a channel 200 feet wide and 16 feet deep from Green Bay up the Menominee River as far as the funds available would allow, the object being to create a navigable channel 16 feet deep from Green Bay to N. Ludington Company's mill, a distance of about 2 miles. The project has been modified by reducing the upper 2,600 linear feet to a width of 100 feet.

The total amount expended up to close of fiscal year ending June 30, 1891, was $11,072.32 in dredging 26,058 cubic yards of material. The depth at the close of the year was 13 feet through a narrow and intricate channel from the harbor piers up to the mill above mentioned.

During the fiscal year ending June 30, 1892, $27,072.69 was expended in dredging and the work is still in progress.

The lower section of 6,550 feet in length has now a channel 200 feet wide and 16 feet deep. The middle section, 2,750 feet long, has been dredged to a depth of 16 feet for a varying width of 90 to 170 feet. Upon the upper section of 2,400 feet no work has yet been done. The channel has a depth of from 1 to 13 feet.

July 1, 1891, balance unexpended		$42,927.68
June 30, 1892, amount expended during fiscal year		27,072.69
July 1, 1892, balance unexpended		15,854.99
July 1, 1892, outstanding liabilities	$884.39	
July 1, 1892, amount covered by uncompleted contracts	8,354.05	
		9,238.44
July 1, 1892, balance available		6,616.55
Amount appropriated by act approved July 13, 1892		20,500.00
Amount available for fiscal year ending June 30, 1893		27,116.55

(See Appendix I I 5.)

6. *Oconto Harbor, Wisconsin.*—In its natural condition the channel at the entrance to the Oconto River was obstructed by a bar with less than 2 feet of water over it. Previous to 1881, when the first appropriation was made for its improvement, the citizens, by the construction of a small amount of slab pier and by dredging, had increased the depth to 3½ feet.

The project of improvement, adopted in 1882, proposes to secure an 8-foot channel from Green Bay to the city of Oconto, a distance of 2 miles, by dredging and constructing piers, at an estimated cost of $150,000.

The total amount expended up to June 30, 1891, was $65,034.87, resulting in the building of two piers, the north pier 1,603 feet, and the south pier 2,151 feet in length, the latter being the full length contemplated by the approved project, and in the removal of 405,356 cubic yards of material. Owing to the narrowness of the dredged channel and the soft character of the material the spring freshets have a tendency to obliterate the dredging of the previous year.

During the fiscal year ending June 30, 1892, the north pier, which was seriously damaged by a freshet in April, 1891, was repaired by driving a line of piles along the channel-face for a length of 750 feet, 3 feet apart from center to center, and secured by wales and binders.

Soundings taken in May, 1892, show the governing depth to be about 7½ feet at the harbor entrance and about 6½ feet in the river as far up as Spies's mill.

July 1, 1891, balance unexpended	$2,965.13
June 30, 1892, amount expended during fiscal year	2,855.90
July 1, 1892, balance unexpended	109.23
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	3,109.23
Amount (estimated) required for completion of existing project	79,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix I I 6.)

7. *Pensaukee Harbor, Wisconsin.*—The original depth of water at the

mouth of the Pensaukee River was 2 feet, increased by private enterprise to from 7 to 9 feet for a width of 30 feet.

The project for the improvement of this harbor was adopted in 1883 and consisted of the construction of a single slab pier 2,500 feet long, in continuation of the pier built by private enterprise, and dredging a channel 10 feet deep and 100 feet wide on the south side of the pier.

The total amount expended up to June 30, 1891, was $11,267.74, resulting in the construction of 1,300 feet of the proposed extension of the pier and the dredging of 5,698 cubic yards of material, making a channel 25 feet wide and 10 feet deep.

About 600 linear feet of the west end of the pier, damaged by fire in September, 1891, was repaired in October and November, 1891.

The last survey, made in May, 1890, showed the governing depth to be 2.8 feet.

July 1, 1891, balance unexpended	$3,731.26
June 30, 1892, amount expended during fiscal year	2,595.90
July 1, 1892, balance unexpended	1,135.36
Amount (estimated) required for completion of existing project	35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix I I 7.)

8. Green Bay Harbor, Wisconsin.—Before the improvement of this harbor was begun the channel between the mouth of the Fox River and the deep water in Green Bay was circuitous and narrow, with but 6 feet of water at its shoalest point.

The project of improvement was adopted in 1866, and subsequently modified so as to provide increased depth in 1872 and 1874, the object being to provide a dredged channel 200 feet wide, 14 feet deep, and 2 miles long, in place of the natural channel, with a revetted cut across Grassy Island.

There was expended up to the close of the fiscal year ending June 30, 1891, $287,356.20, resulting in a dredged channel 10,600 feet long, 200 feet wide, and 14 feet deep, except where occasional shoals reduced the depth to 13 feet, and in the construction of 1,325 linear feet of revetment of the sides of a cut through Grassy Island.

During the year ending June 30, 1892, $6,395.75 was expended in dredging to complete the 14-foot channel and to remove deposited materials. The present channel is 200 feet wide and 14 feet deep. A modification of the present project was submitted February 12, 1892, for increasing the depth to 16 feet and extending the channel in a direct line through the bar that projects from Sable Point, making its total length about 16,500 feet.

July 1, 1891, balance unexpended	$10,224.80
June 30, 1892, amount expended during fiscal year	6,395.75
July 1, 1892, balance unexpended	3,829.05
Amount appropriated by act approved July 13, 1892	25,000.00
Amount available for fiscal year ending June 30, 1893	28,829.05
Amount (estimated) required for completion of existing project	71,915.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix I I 8.)

9. Harbor of refuge at entrance of Sturgeon Bay Canal, Wisconsin.—Before the construction of this harbor was undertaken, the Lake Michigan entrance to the Sturgeon Bay and Lake Michigan Ship Canal was entirely unprotected from storms ranging from northeast to southwest.

The project of constructing a harbor of refuge at this point was adopted in 1873, and modified in 1879 and 1880. The modified project, as carried out, consists of two piers, each 1,344 feet long, 850 feet apart at the shore line, protecting the lake entrance of the canal, and converging so as to make the harbor entrance 335 feet wide, inclosing an area of about 10 acres, with a depth of at least 16 feet.

The total expenditure at this harbor up to June 30, 1891, was $164,969.65, resulting in the completion of the piers as projected, and in a dredged channel nearly 16 feet deep at the entrance and 14 feet or more thence to the canal, making a depth of 14 feet over the greater part of the sheltered area.

During the fiscal year ending June 30, 1892, there was expended $1,803.75 in repairs to piers and in dredging, which resulted in a channel 16 feet deep and 120 feet wide from the 16-foot contour in Lake Michigan to the canal entrance.

Soundings taken in April, 1892, show that the governing depth has been reduced by deposits of material to about 12 feet.

The restoration of the channel to a depth of 16 feet was begun June 21, 1892, and is in progress at the close of the fiscal year.

July 1, 1891, balance unexpended	$3,025.35
June 30, 1892, amount expended during fiscal year	1,803.75
July 1, 1892, balance unexpended	1,221.60
July 1, 1892, outstanding liabilities	100.00
July 1, 1892, balance available	1,121.60
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	6,121.60
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	7,000.00

(See Appendix I I 9.)

10. Ahnapee Harbor, Wisconsin.—Previous to the improvement of this harbor the depth of water at the mouth of the Ahnapee River was only about 2 feet.

The project of improvement adopted in 1875 and modified in 1884, provided for the formation of a small artificial harbor, connected with the lake by a channel 100 feet wide and 12 feet deep, formed by the construction of two piers extending to the 18-foot contour, with a 200-foot entrance between the pier heads.

The total amount expended up to June 30, 1891, was $161,208.66, resulting in the construction of two piers, the north one 1,102 feet long, and the south one 1,125 feet, and in the removal of 29,876 cubic yards of rock, and 107,638 cubic yards of sand.

During the fiscal year ending June 30, 1892, $4,032.14 has been expended in placing a double row of sheet piling along 352 feet of the north pier and removing 652 cubic yards of rock and 28,205 cubic yards of sand and gravel from the channel. The rock was used for refilling and riprapping the piers.

Soundings made in October, 1891, showed a depth at the entrance of 16½ feet, and thence to the west end of the piers 12 feet.

The Ahnapee and Western Railroad to connect with the Green Bay and Western Railroad is expected to be completed and in operation this season.

July 1, 1891, balance unexpended	$4,726.84
June 30, 1892, amount expended during fiscal year	4,032.14
July 1, 1892, balance unexpended	694.70
Amount appropriated by act approved July 13, 1892	7,000.00
Amount available for fiscal year ending June 30, 1893	7,694.70
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	12,000.00

(See Appendix I I 10.)

11. Kewaunee Harbor, Wisconsin.—The natural entrance to this harbor was through the Kewaunee River. The river mouth was not more than 20 feet wide, with a depth of about 2 feet at its shoalest point, and was obstructed by submerged bowlders.

The project of improvement was adopted in 1881. Its design was to cut a channel 14 feet deep through a neck of land between the river and the lake at a point about 2,000 feet south of the river mouth, and to continue this channel to deep water in the lake by the construction of two parallel piers 200 feet apart, extending from each side of the cut lakeward to the 18-foot contour.

The total amount expended on this harbor up to the close of the fiscal year ending June 30, 1891, was $63,885.14, in addition to which the local harbor commissioners had expended $8,042.72. At that time 1,000 feet of the north pier and 1,075 feet of the south pier had been constructed, and there was a channel 120 feet wide and 14 feet deep.

During the fiscal year ending June 30, 1892, $10,736.79 was expended in extending both piers, the north pier being now 1,250 feet long and the south pier 1,125 feet long. This work was completed September 17, 1891.

Soundings taken in April, 1892, show the governing depth in entrance channel to be about 11½ feet.

The completion in October, 1891, of a railroad between Kewaunee and Green Bay, forming with existing railroads and a line of steamers plying across Lake Michigan between Kewaunee and Frankfort, Mich., a through route of transportation between the Missouri River and the Atlantic seaboard, has greatly increased the importance of this harbor. Two steamers for the carriage of twenty-four cars each between Kewaunee and Frankfort are to be completed and delivered September 1. They are 256 feet over all, 54 feet beam, and are expected to draw 12 feet of water.

July 1, 1891, balance unexpended	$11,080.46
June 30, 1892, amount expended during fiscal year	10,736.79
July 1, 1892, balance unexpended	343.67
Amount appropriated by act approved July 13, 1892	30,000.00
Amount available for fiscal year ending June 30, 1893	30,343.67
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	86,957.28

(See Appendix I I 11.)

12. Two Rivers Harbor, Wisconsin.—Previous to the improvement of this harbor the natural channel was obstructed by a bar covered by but 2 or 3 feet of water.

The project of improvement adopted in 1870 provided for the formation of a channel of navigable width and not less than 12 feet deep, to be accomplished by the construction of two piers extending from the mouth of Two Rivers lakeward to the 18-foot contour in Lake Michigan and dredging a channel between them.

The amount expended up to the close of the fiscal year ending June 30, 1891, was $202,639.02, which was expended in the construction of two parallel piers, the north and south piers being 1,810 and 1,710 feet long, respectively, in dredging, and in repairs to the piers.

There was no work done during the last fiscal year.

A survey completed in May, 1892, showed a channel about 50 feet wide and 9½ feet deep.

July 1, 1891, balance unexpended	$860.98
June 30, 1892, amount expended during fiscal year	261.12
July 1, 1892, balance unexpended	599.86
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	3,599.86
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	59,088.80

(See Appendix I I 12.)

13. Manitowoc Harbor, Wisconsin.—Previous to the improvement of this harbor but 3 feet of water existed at the shoalest point over the bar at the mouth of the Manitowoc River.

The original project adopted in 1852 provided for the construction of two parallel piers, 220 feet apart, extending from the mouth of the river to the 12-foot contour in Lake Michigan. In 1881 this was modified so as to secure a deeper channel by extending the piers to a depth of 18½ feet and dredging to not less than 14 feet.

The total amount expended up to June 30, 1891, was $302,806.41, resulting in the construction of two piers, the north one 1,970 feet and the south one 1,900 feet long, 228 feet apart at the shore line and 250 feet at the outer ends; renewal of superstructure of piers, and in the removal of 194,462 cubic yards of material by dredging.

During the fiscal year ending June 30, 1892, $4,260.97 has been expended in rebuilding 342 feet of superstructure of the north pier and in dredging 2,429 cubic yards of material from the channel.

Soundings taken in April, 1892, showed a depth of water at entrance of 16½ feet, and a navigable channel, midway between the piers, about 14½ feet deep.

July 1, 1891, balance unexpended	$5,120.72
June 30, 1892, amount expended during fiscal year	4,260.97
July 1, 1892, balance unexpended	859.75
Amount appropriated by act approved July 13, 1892	28,000.00
Amount available for fiscal year ending June 30, 1893	28,859.75
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	12,000.00

(See Appendix I I 13.)

14. Sheboygan Harbor, Wisconsin.—Previous to the improvement of this harbor the natural channel had a depth not exceeding 4 feet on the bar at the entrance of the river.

The original project for the improvement of this harbor was adopted in 1852, and had for its object the formation of a 12-foot channel entrance to the mouth of the Sheboygan River. This was modified in

1873 so as to secure a deeper channel by further pier extension and dredging. Both projects were completed within their estimated cost, and a channel was formed 100 feet wide, with a depth of 15 to 16 feet between the piers. This was further modified in 1881, the present project having for its object to deepen the channel still further by extending the piers to the 20-foot contour in the lake and dredging to a depth of 18 feet between their outer ends, the depth decreasing to 14 feet at the shore line.

The total expenditures up to June 30, 1891, amounted to $305,863.28, resulting in the construction of a north and a south pier, 2,120 and 2,387 feet long, respectively, and the removal by dredging of 232,518 cubic yards of material.

In April, 1891, there was a channel about 50 feet wide, with a least depth of 14.3 feet. Dredging was begun in June and completed in August, 1891. Seventeen thousand and thirty cubic yards of material was removed during the fiscal year.

There was expended during the fiscal year ending June 30, 1892, $12,392.75 in pier extension and dredging. The north and south piers are now 2,270 and 2,387 feet long, respectively.

A survey, made in April, 1892, showed a governing depth of water in the channel to be about 13.7 feet.

July 1, 1891, balance unexpended	$12,525.43
June 30, 1892, amount expended during fiscal year	12,392.75
July 1, 1892, balance unexpended	132.68
Amount appropriated by act approved July 13, 1892	25,000.00
Amount available for fiscal year ending June 30, 1893	25,132.68
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	42,000.00

(See Appendix I I 14.)

15. Port Washington Harbor, Wisconsin.—The natural channel at the mouth of the Sauk River was narrow and at the shoalest point had a depth of but 1 foot.

The original project for the improvement of this harbor was adopted in 1869 and provided for two parallel piers extending to 10 feet of water in Lake Michigan and the excavation of an interior basin. This plan was modified in 1870 and again in 1876, and now provides for the excavation of two interior basins with a combined area of 5¾ acres, with a depth of 12 feet, and a channel of the same depth connecting the basins with the lake.

The total expenditure up to June 30, 1891, was $174,473.20, and resulted in the construction of a north and south pier, 920 and 1,226 feet long, respectively, with 400 feet of revetment along the north bank of the river, extending to the inner end of the south pier; in the formation of two interior dredged basins of 2¾ and 3 acres, respectively. The north basin had a depth of 12 feet over nearly its entire area, and a narrow channel 12 feet deep from abreast the inner end of the north pier to the upper end of the west basin, although the average depth did not exceed 8 feet.

There was expended during the fiscal year ending June 30, 1892, $2,901.34 in dredging 14,360 cubic yards of material from the entrance channel and basins, and refilling and riprapping cribs of the piers with about 40 cords of stone.

Soundings taken in May, 1892, indicated a ruling depth of water in the entrance channel of 10½ feet.

July 1, 1891, balance unexpended	$3,034.70
June 30, 1892, amount expended during fiscal year	2,901.34
July 1, 1892, balance unexpended	133.36
Amount appropriated by act approved July 13, 1892	6,500.00
Amount available for fiscal year ending June 30, 1893	6,633.36
Amount (estimated) required for repairs and dredging Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	10,000.00

(See Appendix I I 15.)

16. Harbor of refuge at Milwaukee Bay, Wisconsin.—The project for the work was approved in 1881 and contemplated the formation of an artificial harbor by inclosing a portion of Lake Michigan forming Milwaukee Bay within a breakwater of crib-work upon a stone foundation. This harbor will furnish 417 acres of safe mooring ground beyond the 18-foot contour and about twice this area beyond the 12-foot contour.

The actual length of the breakwater when completed will be 7,250 feet.

Work began in 1881, and up to June 30, 1891, there had been expended $404,121.81, 3,650 feet of substructure, and 3,325 feet of superstructure being completed.

During the fiscal year ending June 30, 1892, 500 additional feet of substructure and 525 feet of superstructure were added at an expenditure of $65,022.71, including cost of care, repairs, and lighting. There remain to be constructed 3,100 feet of substructure and 3,400 feet of superstructure to complete the work.

The harbor is now used to a considerable extent as a shelter from northeast storms, and its value will rapidly increase as the breakwater is extended.

July 1, 1891, balance unexpended	$81,078.76
June 30, 1892, amount expended during fiscal year	65,022.71
July 1, 1892, balance unexpended	16,056.05
Amount appropriated by act approved July 13, 1892	75,000.00
Amount available for fiscal year ending June 30, 1893	91,056.05
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	234,739.91

(See Appendix I I 16.)

17. Milwaukee Harbor, Wisconsin.—The original depth of water at the mouth of the Milwaukee River was not more than 3½ feet.

The original project was adopted in 1852, and was directed to securing 12 feet of water at the entrance to the river and to protecting the channel by parallel piers. In 1868 this was modified so as to secure a channel 18 feet deep by extending the piers 600 feet and dredging. The project has been completed, and consequently the only expenditures now demanded are for the maintenance of the piers by timely repairs and of the depth of the channel by dredging.

Up to the close of the fiscal year ending June 30, 1891, there had been expended on this harbor $324,627.85, in addition to $321,355.66 expended by the city of Milwaukee, resulting in the completion of the modified project of 1868.

During the fiscal year ending June 30, 1892, $5,752.62 has been expended for dredging between the piers to a depth of 18 feet for a width of 162 feet.

Soundings taken in May, 1892, show that a deposit of material has been made in the channel-way since November, 1891, of about 0.8 feet, leaving a depth of water way of 17 feet. Outside the pier-heads the water is fully 18 feet deep below the datum plane.

July 1, 1891, balance unexpended	$6,550.13
June 30, 1892, amount expended during fiscal year	5,752.62
July 1, 1892, balance unexpended	797.51
Amount appropriated by act approved July 13, 1892	14,000.00
Amount available for fiscal year ending June 30, 1893	14,797.51

(See Appendix I I 17.)

18. *Racine Harbor, Wisconsin.*—The entrance to this harbor originally varied in depth from absolute closure after storms to about 6 feet.

The original project was adopted in 1842 or 1843, and contemplated a channel 12 feet deep. In 1866 the project was modified to provide a channel 15 feet deep.

The project was further modified in 1889, providing for 300 feet extension to the north pier, 500 feet to the south pier, and an increase of channel depth of water to 16 feet.

There has been expended up to June 30, 1891, $263,783.83 in the construction of a north and a south pier 1,460 and 1,070 feet long respectively, and in dredging the channel to 16 feet depth of water.

During the fiscal year ending June 30, 1892, $16,642.71 has been expended in extending the south pier 200 feet (making it now 1,270 feet long), and in dredging the channel restoring it to 15 feet in depth for a width of 80 feet.

Soundings taken in April, 1892, show that 13 feet of water can be carried into the harbor, but to again restore the channel to a depth of 15 feet for a width of 80 feet would require about 13,000 cubic yards of dredging.

The constant shoaling at the entrance to this harbor shows that the piers will have to be extended several hundred feet in order to maintain the intended depth. Some 1,100 feet of the superstructure of the piers should be rebuilt.

July 1, 1891, balance unexpended	$17,643.88
June 30, 1892, amount expended during fiscal year	16,642.71
July 1, 1892, balance unexpended	1,001.17
Amount appropriated by act approved July 13, 1892	25,000.00
Amount available for fiscal year ending June 30, 1893	26,001.17
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	39,500.00

(See Appendix I I 18.)

19. *Kenosha Harbor, Wisconsin.*—The original depth of water at the mouth of Pike Creek varied from absolute closure to 3 feet.

The original plan of improvement was adopted in 1852, and was directed to securing a channel 12 feet deep, by constructing parallel piers and dredging between them. This plan was modified in 1866 so as to secure 15 feet of water by extending the piers and dredging deeper.

A further modification of the project was made in 1889, providing for the extension of the north pier 300 and the south pier 600 feet.

There was expended upon this harbor up to June 30, 1891, $240,933,05, resulting in the construction of two piers, north and south, 1,600 and 800 feet in length respectively, 150 feet apart, with a channel of varying depth. In 1875 and 1876 the channel was dredged to 15 feet, but subsequent appropriations sufficed only to maintain a channel of about

12 feet. An area of about 3 acres was also dredged in the inner harbor to a depth of 14 feet. Extension of the south pier 150 feet was in progress, under contract, at the close of the year 1891.

Soundings taken in April, 1892, showed an available depth of channel of only 12½ feet, with a small bank in mid-channel on which there was but 12 feet of water.

During the fiscal year ending June 30, 1892, $11,674.67 was expended in the extension of the south pier 150 feet and in dredging the channel. At the close of the year the work of dredging the channel to restore it to a depth of 15 feet and a width of 80 feet was in progress. The channel can be maintained only by frequent dredging until the piers are further extended.

July 1, 1891, balance unexpended	$16,049.03
June 30, 1892, amount expended during fiscal year	11,674.67
July 1, 1892, balance unexpended	4,374.36
July 1, 1892, outstanding liabilities	1,491.84
July 1, 1892, balance available	2,882.52
Amount appropriated by act approved July 13, 1892	15,000.00
Amount available for fiscal year ending June 30, 1893	17,882.52
Amount (estimated) required for completion of existing project	49,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix I I 19.)

20. Waukegan Harbor, Illinois.—Previous to improvement there was no navigable channel or natural harbor at this place, the adopted project contemplating the construction of an artificial harbor.

A project was adopted in 1852 which provided for the construction of a breakwater parallel to the shore in 20 feet of water. One crib was placed in position, but was carried away by a storm.

The present project was adopted in 1880, and provides for the construction of an exterior basin of sufficient capacity for local trade by inclosing a portion of Lake Michigan with pile piers, the entrance channel between the piers and the inclosed area to be dredged to 12 feet.

There has been expended on this harbor up to the close of the fiscal year ending June 30, 1891, $124,473.20, resulting in the construction of 2,477 feet of pile pier and the removal of 80,874 cubic yards of material.

During the fiscal year ending June 30, 1892, $13,027.07 was expended in building 200 feet extension to north pier, 202 feet extension to south pier, constructing two sand fences 176 feet and 128 feet long respectively, and in beginning the work of dredging the channel and basin to a uniform depth of 12 feet below datum plane. At the close of the year 9,714 cubic yards of material had been excavated.

Soundings taken in April, 1892, showed a narrow channel of 7 feet in depth near the north pier.

July 1, 1891, balance unexpended		$25,526.80
June 30, 1892, amount expended during fiscal year		13,027.07
July 1, 1892, balance unexpended		12,499.73
July 1, 1892, outstanding liabilities	$1,169.39	
July 1, 1892, amount covered by uncompleted contracts	7,830.61	
		9,000.00
July 1, 1892, balance available		3,499.73
Amount appropriated by act approved July 13, 1892		25,000.00
Amount available for fiscal year ending June 30, 1893		28,499.73

Amount (estimated) required for completion of existing project....... $61,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix I I 20.)

21. Fox River, Wisconsin.—The works for the improvement of the Fox River were purchased by the United States from the Green Bay and Mississippi Canal Company in 1872. With the exception of one stone lock, they were all temporary structures and were in bad condition. There was no low-water navigation on the Upper Fox, and on the Lower Fox navigation was uncertain.

The adopted project for the improvement of the Fox River contemplated the replacing of the temporary structures with permanent works, the construction of five additional stone locks on the upper river, and widening and deepening the channels throughout the river and canals to 6 feet depth and 100 feet width. The estimate for both rivers, made in 1874 and 1876, was $3,745,663.

The work is now carried on under the project of a Board of Engineers, submitted September 17, 1884, published in the Annual Report of the Chief of Engineers for 1885, approved by the Secretary of War December 10, 1885, as further modified by authority of the Chief of Engineers May 14, 1886.

The project provides for the renovation of eleven old locks, and the deepening and widening of the channel of the Fox River from Montello to Green Bay to 6 feet depth and 100 feet width, and that from Portage to Montello 4 feet of water at low water be maintained, the estimate for which was $602,000.

The amount expended on the Fox and Wisconsin rivers from 1867 up to the close of the fiscal year ending June 30, 1891, including $145,000 paid to the Green Bay and Mississippi Canal Company for works of improvement under act of June 10, 1872, was $2,605,090.24, and under modified project for the Fox River $239,689.45, making a total of $2,844,779.69.

The result of the expenditure upon the Fox River was: The construction of 14 new locks of stone; 17 dams, 4 of which are temporary; 12 cut-offs; a head wall and feeder at the old first lock at Appleton; a wing dam of brush and stone for a shore protection to the Portage Levee; a new tugboat and dump scows; dredged channels at Grignon Rapids, mouth of Fond du Lac River, and between De Pere and Green Bay; in the canals, and the Upper Fox River.

During the season of 1891 on the Lower Fox boats drawing 5 feet of water could run from Green Bay to Oshkosh until about August 1, when the mills at Neenah, Menasha, Appleton, and Kaukauna had drawn the water so low below the crests of the dams that there was not over 3 feet of water in the channel, and at times there was a depth of but 6 inches on the breast wall of the Kaukauna first lock. On the upper river, on account of the low water during September, the larger boats were obliged to lay up for the remainder of the season. Navigation was closed by ice November 17, 1891, and resumed on the upper river April 10, 1892.

Under the present project there remain to be done 2,600,000 cubic yards of dredging on the Upper Fox and 50,000 cubic yards of dredging and rock excavation on the Lower Fox.

During the fiscal year ending June 30, 1892, $41,575.61 was expended, and the following work done: Guard gates at head of Kaukauna Canal completed; a channel 75 feet wide and 450 feet long was blasted and excavated through the rock bar below De Pere lock to a depth of from 4 to 12 inches below top of lower miter sill of the lock. The channel at Grignon Rapids above upper dam at Appleton was deepened to 7 feet below crest of dam except for about 500 feet, where solid rock was encountered, which will require blasting. The channel between De Pere and Green Bay was deepened to 12½ feet for a width of from 50 to 60 feet. Dredging was also done in the Neenah Channel, at the mouth of the Fond du Lac River, and at the entrance of Fox River into Lake Butte des Morts..

July 1, 1891, balance unexpended	$76,470.31
June 30, 1892, amount expended during fiscal year	41,575.61
July 1, 1892, balance unexpended	34,894.70
July 1, 1892, outstanding liabilities	1,156.41
July 1, 1892, balance available	33,738.29
Amount appropriated by act approved July 13, 1892	75,000.00
Amount available for fiscal year ending June 30, 1893	108,738.29
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	271,000.00

(See Appendix I I 21.)

22. *Operating and care of locks and dams on Fox River, Wisconsin.*—Under the continuous appropriation for operating and care of canals and other works of navigation, it is proposed to maintain existing navigation by timely repairs to old locks until they are replaced by new, and to continue repairs of works that have already been completed and used, injured by floods or otherwise.

The amount expended under the indefinite appropriation provided by section 4 of the river and harbor act of July 5, 1884, up to the close of the fiscal year ending June 30, 1891, was $377,768.71.

During the fiscal year ending June 30, 1892, $55,989.98 has been expended, the detailed statement appended to the report of the local engineer officer showing the items of expenditure.

July 1, 1891, balance unexpended	$63,998.29
June 30, 1892, amount expended during fiscal year	55,989.98
July 1, 1892, balance unexpended	8,008.31
July 1, 1892, outstanding liabilities	6,176.96
July 1, 1892, balance available	1,831.35
Amount allotted for expenditure in fiscal year ending June 30, 1893	40,000.00
Amount available for fiscal year ending June 30, 1893	41,831.35

(See Appendix I I 22.)

IMPROVEMENT OF CHICAGO AND CALUMET HARBORS, ILLINOIS, OF CALUMET RIVER, ILLINOIS AND INDIANA, AND OF ILLINOIS RIVER, ILLINOIS; ILLINOIS AND MISSISSIPPI CANAL.

Officer in charge, Capt. W. L. Marshall, Corps of Engineers, with Lieut. Chester Harding, Corps of Engineers, under his immediate orders since May 23, 1892; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Chicago Harbor, Illinois.*—The present project was adopted in 1870, and contemplated:

a. The formation of an outer harbor or basin, by inclosing a portion of Lake Michigan just south of and adjoining the entrance to Chicago River for the purpose of increasing the harbor facilities of Chicago.

b. The construction of an exterior breakwater in deep water north of the entrance to Chicago River and about 1 mile distant, to shelter the approach to the river and outer harbor entrance, and to form a harbor of refuge at the southern end of Lake Michigan.

There has been expended upon this project since 1870, $1,710,828.95, which expenditure has resulted in the completion of the outer harbor, except 267,000 cubic yards of dredging still remaining to be done to attain 16 feet depth of water at low water throughout the required basin; in the completion of the exterior breakwater, 5,413 feet in length; in keeping the entrance to Chicago River, which constitutes the harbor of Chicago, dredged; in maintaining the various piers and breakwaters; and in maintaining in serviceable condition the plant pertaining to the work.

During the fiscal year ending June 30, 1892, the work consisted in:

a. Exterior breakwater.—No work was done upon this construction, it having been completed during the previous year.

b. Outer basin and north pier, Chicago Harbor.—Under contract made in the previous year the work of rebuilding superstructure over the easterly breakwater and return and over the north pier was continued and completed; damages caused by collisions to these piers were repaired, and the end of the north pier and the angle at the "return" were protected by pier heads and clumps of piles.

This work included 2,542 linear feet of superstructure 6 feet in height, and 997.8 linear feet of superstructure 8 feet high, making the total work under this contract 5,240.3 linear feet of new structure.

Snubbing posts for the benefit of vessels making up their tows near the mouth of the harbor were also placed at suitable intervals along the north pier.

No dredging has been required during the year.

The superstructures over the southerly breakwater, outer basin, built in 1879-'80, and over 1,225 linear feet south pier entrance to Chicago River, built in 1869-'70, are now in need of renewal, and there should be rebuilt at an early date 3,140 linear feet of superstructure (built in 1881-'82) over the westerly end of the exterior breakwater.

There is also material amounting to 267,000 cubic yards still to be dredged from the outer basin to complete the project.

The outer basin has never fulfilled the purposes of its construction on account of the litigation that has existed for many years as to the riparian ownership along the lake front, and the dredging in that basin may well be postponed until the lake front of this basin is in demand for harbor and dock purposes, when the material will be necessary for filling wharves and docks.

July 1, 1891, balance unexpended	$96,003.20
June 30, 1892, amount expended during fiscal year	94,393.43
July 1, 1892, balance unexpended	1,609.77
July 1, 1892, outstanding liabilities	184.76
July 1, 1892, balance available	1,425.01
Amount appropriated by act approved July 13, 1892	72,000.00
Amount available for fiscal year ending June 30, 1893	73,425.01
Amount (estimated) required for maintenance, repair, and preservation of superstructures	80,000.00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

(See Appendix J J 1.)

2. *Calumet Harbor, Illinois.*—This improvement is to furnish a safe and practicable entrance to Calumet River and the port of South Chicago by parallel piers 300 feet apart, extending from shore to deep

water in the lake, and by dredging between them to 16 feet in depth at low water.

The work commenced in 1870 and at the close of the fiscal year ending June 30, 1892, there had been expended $423,932.05, as the result of which 3,640 linear feet of the north pier and 2,020 linear feet of the south pier have been completed, 471,364 cubic yards of material dredged giving a channel 16 feet in depth instead of 7 feet as originally existed.

During the fiscal year ending June 30, 1892, 57,930 cubic yards of material was removed by dredging under contract.

The channel is now 250 feet in width, 16 feet in depth below extreme low water in Lake Michigan, and extends from a similar depth in Lake Michigan to the beginning of the 16-foot channel in the Calumet River.

The superstructures over parts of the piers of this harbor have been reported in a deplorable state of decay for years. The work of time continues and there is now a length of about 2,300 linear feet of superstructure that is worthless and some 600 linear feet now in very bad condition.

The 2,300 linear feet of superstructure should be at once renewed, and the estimate herewith is entirely for maintenance.

July 1, 1891, balance unexpended	$20,930.54
June 30, 1892, amount expended during fiscal year	12,474.59
July 1, 1892, balance unexpended	8,455.95
Amount appropriated by act approved July 13, 1892	15,000.00
Amount available for fiscal year ending June 30, 1893	23,455.95
Amount (estimated) required for maintenance	36,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix J J 2.)

3. *Calumet River, Illinois and Indiana.*—The object of this improvement as far as projected is to secure a channel 200 feet in width and 16 feet in depth below low-water plane in Lake Michigan, from the mouth of the Calumet River at Calumet Harbor, Illinois, to one half mile east of Hammond, Ind., with a view to increasing the facility for handling the commerce of this region and also to aid in providing means for the better accommodation of much of the commerce of Chicago River, which river is very much crowded. The original depth of navigation in this river varied from 6 to 10 feet.

The various acts of Congress and the limitations made by law upon the expenditure of the appropriations thereby made before work was systematically inaugurated upon this improvement are given in the Annual Report of the Chief of Engineers for the year ending June 30, 1889.

At the beginning of the fiscal year work was in progress under a contract with the lowest responsible bidder for dredging the river from near One hundred and eighth street to near One hundred and thirteenth street, Wheeler & Pursell, of Portsmouth, Ohio.

During the past fiscal year this contract was completed. Under its terms 365,719 cubic yards of material was removed, on which 273,456 cubic yards was removed during the fiscal year ending June 30, 1892.

Since the beginning of the improvement there has been removed 1,137,456 cubic yards of material, making a channel 3 miles and 345 feet in length, of which a short portion, where rock and other undredgeable material was encountered, is incomplete, there remaining less than 9,000 cubic yards to be removed.

This material can be most economically removed after all of this class shall have been revealed by further work.

No work has been done during the fiscal year upon the section of the Calumet River between the Forks and one-half mile east of Hammond, Ind.

The amount expended by the United States to the close of the fiscal year ending June 30, 1892, is $170,491.09, of which $143,797.34 has been expended between the mouth of the Calumet River and One hundred and eighth street, including $5,000 paid for legal expenses in securing rights of way and releases from damages claims, required by the act of July 5, 1884, and $25,693.75 for work between the Forks of the Calumet and one-half mile east of Hammond, Ind.

July 1, 1891, balance unexpended	$44,401.37
June 30, 1892, amount expended during fiscal year	34,892,76
July 1, 1892, balance unexpended	9,508.61
July 1, 1892, amount covered by uncompleted contracts	9,217.24
July 1, 1892, balance available	291.37
Amount appropriated by act approved July 13, 1892	75,000.00
Amount available for fiscal year ending June 30, 1893	75,291.37
Amount (estimated) required for completion of existing project	745,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix J J 3.)

4. *Illinois River, Illinois.*—The present project contemplates the extension of the work heretofore done by the State of Illinois from the mouth of Copperas Creek to the Mississippi River, a distance of about 135 miles, which project includes the building of two locks 350 feet long between miter sills, 75 feet in width of lock chamber, with 7 feet of water over the miter sills at low-water level of 1879, and dredging the channel where necessary to attain 7 feet depth at low water in the pools thus created.

The sites selected for the two locks are one at Kampsville, 31 miles above the mouth of the Illinois, the other at La Grange, 79 miles above the mouth of the river.

The ultimate object of the improvement is the construction of a ship canal from the southern end of Lake Michigan to the Mississippi River of sufficient capacity to accommodate large-sized Mississippi River steamboats and for military and naval purposes.

The State of Illinois, aided by the United States, has executed part of the project by the construction of two locks of the dimensions above stated, one at Henry and one at Copperas Creek, respectively, completing, except dredging, that part of the improvement between La Salle, Ill., and the mouth of Copperas Creek.

The La Grange Lock and Dam are practically completed and in use. The Kampsville Lock and the abutment of the dam are nearing completion, the foundations and five-sixths of the masonry being now in place in the walls, all of the additional stone required has been purchased, and with the exception of a small amount, now on hand at the lock site, all of the timber and iron work for the lock gates, and one-third the timber and all of the rock for the dam is contracted for, but not yet delivered.

There remains to be done under the project the following work:

At La Grange Lock some 2,500 cubic yards of riprap to be placed below the dam to protect the river bottom against scour and an additional small building to accommodate the lock-tenders and skilled labor.

The greater part of this work will be done by the regular lock force.

The Kampsville Lock and Dam is to be completed, and some 2,000,000 cubic yards of dredging in the pools.

In executing this work the United States have expended up to June 30, 1892, including $25,000 expended from the appropriation of August 11, 1888, for surveys and exclusive of $62,359.80 expended upon the foundation of the Copperas Creek Lock afterwards completed by the State of Illinois, the sum of $1,066,918.19.

An additional amount ot $747,747 was expended by the State of Illinois on the locks and dams at Henry and Copperas creeks.

During the fiscal year ending June 30, 1892, the following work was done:

a. La Grange Lock.—A revetment 212 feet long was built above the land wall of the lock, an ice-protection crib was built above the river head wall, and the necessary dredging done to maintain navigation.

b. Kampsville Lock.—The foundation of this lock was cleared of mud, 9,000 cubic yards; the remainder of the deposit since 1883, 34,000 cubic yards in all, was removed partly by dredging and partly by hand.

Traveler trestles and machinery for laying up the lock walls were placed and 10,145 cubic yards of masonry laid, completing the masonry up to and including course L.

The foundation of the abutment of the dam was prepared and 196 cubic yards of masonry laid thereon; 27,479 cubic yards of material was dredged from above and below the lock pit. All of the remaining stone for the lock was purchased under contract, and 6,915 cubic yards riprap stone for the dam purchased and piled at the lock site.

The quarters and plant have been maintained in serviceable condition, but the hulls of all floating property are in a very bad state of decay, making its maintenance and service very costly and unsatisfactory. The small appropriations and nearness to completion of the work have made renewals inadvisable save where absolutely necessary.

July 1, 1891, balance unexpended		$159,304.43
June 14, 1892, amount refunded on account of loss of goods		5.50
		159,309.93
June 30, 1892, amount expended during fiscal year		103,999.07
July 1, 1892, balance unexpended		55,310.86
July 1, 1892, outstanding liabilities	$340.45	
July 1, 1892, amount covered by uncompleted contracts	24,715.57	
		25,056.02
July 1, 1892, balance available		30,254.84
Amount appropriated by act approved July 13, 1892		100,000.00
Amount available for fiscal year ending June 30, 1893		130,254.84
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		112,500.00

(See Appendix J J 4.)

5. *Operating and care of La Grange Lock and Dam, Illinois River, Illinois.*—This lock and dam have been maintained and operated under the general indefinite appropriation for "operating and care of canals and other works of navigation," contained in the river and harbor act of July 5, 1884, section 4. The approaches to the lock have been kept dredged and the lock maintained in serviceable condition by necessary repairs.

Twelve thousand five hundred and eighteen cubic yards of dredging was done, part of the material being placed behind shore revetments. An ice breaker and 212 feet of revetment along shore above the lock were constructed.

Navigation was practically suspended during September, October, and November due to low water in the river below the lock.

Two hundred and eighteen lockages of steamboats were made and 91 boats passed over the dam, showing a decrease in number of steamers passing the lock during the year of about 30 per cent.

The tonnage, however, passing the lock increased from 44,000 tons to 138,000 tons, or was more than tripled in volume over the preceding year.

July 1, 1891, balance unexpended (reported outstanding June 30, 1891)	$834.47
July 29, 1891, allotment	10,000.00
	10,834.47
June 30, 1892, amount expended during fiscal year	8,004.06
July 1, 1892, balance unexpended	2,830.41
July 1, 1892, outstanding liabilities	238.00
July 1, 1892, balance available	2,592.41

(See Appendix J J 5.)

6. *Illinois and Mississippi Canal.*—The object of this improvement is to furnish a link in a navigable water route from Lake Michigan, at or near Chicago, Ill., to the Mississippi River, at the mouth of Rock River.

The canal is located upon the route approved by the Secretary of War October 27, 1888, from the Illinois River, about 1¾ miles above the town of Hennepin, at the great bend of the Illinois River, thence via Bureau Creek Valley to Rock River at Penney Slough, thence by slack water and a short canal around the lower rapids of Rock River, to its mouth.

The canal to be 80 feet wide at the water surface, 7 feet deep, and with lock chambers 170 feet in length and 35 feet in width.

A report upon the detailed location, plans, and estimates for the construction of this canal was submitted June 21, 1890, and published by Congress as House Ex. Doc. No. 424, Fifty-first Congress, first session.

The river and harbor act of September 19, 1890, made the first appropriation for the construction of this canal, and directed work to be begun by the construction of one of the locks and dams on Rock River.

During the fiscal year ending June 30, 1891, the section of the canal around the lower rapids of Rock River had been definitely located by approval of the Secretary of War dated March 25, 1891, and full legal descriptions and plats of all lands required for this section had been placed in the hands of the Department of Justice.

This location was disputed by interests centering in the city of Rock Island, Ill., and by direction of the Secretary of War the question was reopened as to the western terminus of the Illinois and Mississippi Canal, which question was narrowed down to whether the north or south bank of Rock River should be followed to its mouth.

A Board of Engineers, convened by Special Orders No. 48, Headquarters, Corps of Engineers, August 18, 1891, affirmed, in their report dated September 12, 1891, the location along the south bank of Rock River, as approved by the War Department March 25, 1891.

The title to the right of way along this section of nearly 5 miles has accordingly been acquired by condemnation, with the exception of the crossing of the Rock Island and Peoria Railroad, which condemnation case is still upon the docket of the United States district court for the northern district of Illinois, southern division.

Bids have been solicited and opened and contracts awarded for the construction of 3 miles of canal trunk, for excavating the lock pits for three locks, and for furnishing sand and pebbles for use in constructions along the canal. Other parts of the work will be put under contract as soon as the right of way across the Rock Island and Peoria Railroad is secured.

Long-continued high water is delaying the inception of the work, but fair progress is expected during the remainder of the season.

As fast as the legal obstacles may be removed by the acquisition of the right of way for the canal, the work will be extended, and it is advisable, if practicable, to provide for the continuous prosecution of the work. Under annual appropriations, rights of way are sought sufficient to begin work to the extent of the appropriation, including constructions and sites therefor, under which method of procedure actual constructions are delayed necessarily for long periods after appropriations therefor are made.

July 1, 1891, balance unexpended	$489,031.10
June 14, 1892, refunded on account of overpayment	.50
	489,031.60
June 30, 1892, amount expended during fiscal year	25,235.61
July 1, 1892, balance unexpended	463,795.99
July 1, 1892, outstanding liabilities	189.42
July 1, 1892, balance available	463,606.57
Amount appropriated by act approved July 13, 1892	500,000.00
Amount available for fiscal year ending June 30, 1893	963,606.57
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	5,925,960.00

(See Appendix J J 6.)

IMPROVEMENT OF RIVERS AND HARBORS ON EASTERN SHORE OF LAKE MICHIGAN.

Officer in charge, Maj. William Ludlow, Corps of Engineers; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Petoskey Harbor, Michigan.*—As reported last year, the act of September 19, 1890, appropriated $15,000 towards the construction of a "breakwater and harbor of refuge" at this place pursuant to a project submitted December 21, 1889 (Annual Report, 1890, pages 2674, 2675), the estimated cost of which was $170,000. Petoskey Harbor is practically an open roadstead on the south side of Little Traverse Bay, and as the amount appropriated was insufficient to accomplish any useful result, it was held by authority of the Secretary of War awaiting further action of Congress.

The river and harbor act approved July 13, 1892, appropriated $20,000 for this harbor and made the funds available for work on the smaller estimate of December 21, 1889, amounting to $70,000.

July 1, 1891, balance unexpended	$15,000.00
July 1, 1892, balance unexpended	15,000.00
Amount appropriated by act approved July 13, 1892	20,000.00
Amount available for fiscal year ending June 30, 1893	35,000.00
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	35,000.00

(See Appendix K K 1.)

2. *Charlevoix Harbor and entrance to Pine Lake, Michigan.*—The harbor of Charlevoix penetrates the peninsula between Great and Little Traverse bays, and furnishes access to Round and Pine lakes. Prior to improvement the entrance depth varied from 2 feet to 6 feet, and the project of 1868, revised in 1876 and 1884, provides for a navigable depth of 12 feet between piers and revetments, 100 to 150 feet apart, from Lake Michigan to Round Lake, and thence to Pine Lake, 83 feet apart.

The expenditure to July 1, 1891, was $96,269.80. The project is not fully completed, and, as at most of the other harbors on the east coast of Lake Michigan, the wave and wind action constantly tends towards the formation of sand bars near the entrance, which involves the annually recurring need of a dredge to remove. From 10 to 12 foot navigation is maintained by this means, but the increasing draft of lake vessels suggests the desirability of an extension of the piers to reach the 15-foot contour in the lake, and thereby furnish more efficient protection for the 12-foot channel.

The expenditure for the fiscal year was $3,674.44, mainly for repairs, the dredging done in May and June, 1891, sufficing to keep the navigation open during last season. At the opening of navigation this spring there was but 10 feet of water, and the Government dredge is about to deepen it.

July 1, 1891, balance unexpended	$6,230.20
June 30, 1892, amount expended during fiscal year	3,674.44
July 1, 1892, balance unexpended	2,555.76
July 1, 1892, outstanding liabilities	247.12
July 1, 1892, balance available	2,308.64
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	12,308.64
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	73,500.00

(See Appendix K K 2.)

3. *Frankfort Harbor, Michigan.*—The unimproved channel between Lake Michigan and Lake Aux Becs Scies had 3 feet or 4 feet of water, and the project of 1866, revised in 1868 and 1879, was to make a 12-foot navigation protected by piers and revetments 200 feet apart. The project is not completed, but with the aid of occasional dredging 10 to 12 feet is maintained.

The total expenditures to July 1, 1891, were $259,882.27, and for the last year $3,629.59. As in other cases an extension of the piers to the 15-foot contour in the lake is needed.

The harbor was thoroughly dredged to 14 feet in July and August, 1891, and the navigation was quite satisfactory during the remainder of the season. At the opening of navigation in 1892 11 feet only was found on the outer bar, but by June 30 this was increased to 13 feet, mainly by the rise in the lake level.

July 1, 1891, balance unexpended	$8,056.08
June 30, 1892, amount expended during fiscal year	3,629.59
July 1, 1892, balance unexpended	4,426.49
July 1, 1892, outstanding liabilities	10.00
July 1, 1892, balance available	4,416.49
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	14,416.49

(See Appendix K K 3.)

4. *Harbor of refuge at Portage Lake, Michigan.*—The lake was adopted as a harbor of refuge, and the project of 1879, modified in 1880 and 1881, contemplated a navigable entrance depth of 18 feet between piers and revetments 370 feet apart. Little has been done towards the accomplishment of this project, the appropriations having been quite disproportionate to the purpose, and the works that have been put up are falling down from age and decay. The entrance is chronically choked with sand and a precarious channel of 7 feet to 9 feet is kept open by dredging. As the 10-foot contour in the lake is 250 feet outside the piers, nothing better is to be expected until something effective is done towards carrying out the project.

The total expenditures to July 1, 1891, were $93,041.85 and for the past fiscal year $2,014.07. The harbor has been again dredged recently, in June, making a through cut 40 feet wide and 13 feet deep. No attempt has been made to repair the tumbled-down piers, as it would be a waste of money, in the absence of thorough treatment, as the piers are in ruinous condition, and a gap of some 400 feet in the north pier gives full sweep of the sea through it.

The commerce of Lake Michigan needs a harbor of refuge in this vicinity, as there is no safe point of shelter in westerly gales between Ludington and South Manitou, a distance of about 80 miles.

July 1, 1891, balance unexpended	$7,458.15
June 30, 1892, amount expended during fiscal year	2,014.07
July 1, 1892, balance unexpended	5,444.08
July 1, 1892, outstanding liabilities	1,337.47
July 1, 1892, balance available	4,106.61
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	167,000.00

(See Appendix K K 4.)

5. *Manistee Harbor, Michigan.*—As originally improved at local cost, by the building of rough slab piers, the channel at the entrance had 7 and 8 feet of water. The project of 1867, revised in 1871, 1873, and 1875, provided for 12 feet between piers 180 feet apart. As again revised in 1890, the project was to deepen the navigation to 15 feet, and extend it to connect with Manistee Lake through the river where the ordinary depth was limited to about 10 feet.

The work of dredging the river was completed in August, 1891, making a channel 15 feet in depth, with a width of 50 feet in the upper portion increased to 75 feet and 100 feet as the entrance was approached.

In May, 1892, the river channel had shoaled to 13 feet, owing to the narrowness of the stream, the unprotected state of the banks, and the large number of vessels using it. Four cribs were added to the north pier and repairs were made to the north revetments.

The total expenditures to July 1, 1891, were $262,909.06, and for the fiscal year, $29,760.25.

July 1, 1891, balance unexpended	$35,090.94
June 30, 1892, amount expended during fiscal year	29,760.25
July 1, 1892, balance unexpended	5,330.69
July 1, 1892, outstanding liabilities	510.52
July 1, 1892, balance available	4,820.17
Amount appropriated by act approved July 13, 1892	50,000.00
Amount available for fiscal year ending June 30, 1893	54,820.17
Amount (estimated) required for completion of existing project	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix K K 5.)

6. *Ludington Harbor, Michigan.*—The natural outlet from Pere Marquette Lake was from 5 to 7 feet deep. The project of 1867 proposed a 12-foot navigation and total width of 200 feet. In 1885 this was enlarged to make a harbor of refuge 18 feet deep and entrance width of 400 feet, but in 1890 the proposition was again modified to retain the former width.

The works as projected were completed in November, 1890, the north and south piers having total lengths respectively of 1,450 feet and 2,300 feet, and projecting about a quarter of a mile into the lake. The entrance width at the lake end is 250 feet. With occasional dredging to remove deposits between the piers a satisfactory navigation of 14 to 16 feet has been maintained.

The total expenditure to July 1, 1891, was $342,838.93, and for the past year, $6,377.64.

The dredging done during June and July to 18 feet from lake to lake was effective for the season of navigation, and in April, 1892, there was not less than 14½ feet with the lake 1½ feet below the zero plane.

July 1, 1891, balance unexpended	$9,595.17
June 30, 1892, amount expended during fiscal year	6,377.64
July 1, 1892, balance unexpended	3,217.53
July 1, 1892, outstanding liabilities	18.61
July 1, 1892, balance available	3,198.92
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	8,198.92

(See Appendix K K 6.)

7. *Pentwater Harbor, Michigan.*—The channel into Pentwater Lake was originally a mere drain, later improved to a depth of 4 feet with slab piers.

In 1866 the Government project, amended in 1873 and 1884, proposed to increase the depth to 12 feet between piers and revetments 150 feet apart. The works are not yet complete, and with more or less dredging annually the navigation is kept open to about 10 feet. In fact, with the present extension of the piers, nothing better can be done, as the 10-foot contour in the lake is about at the end of the piers, and the 15-foot contour is 400 feet farther out.

The total expenditure to July 1, 1891, was $226,001.81, and for the past year $5,392.08.

The channel was dredged in August and September, 1891, to 14 feet, but in April, 1892, had again shoaled to 10 feet.

Some repairs were made to the dilapidated portion of the south pier during the last season, and will be continued.

July 1, 1891, balance unexpended	$7,818.19
June 30, 1892, amount expended during fiscal year	5,392.08
July 1, 1892, balance unexpended	2,426.11
July 1, 1892, outstanding liabilities	10.00
July 1, 1892, balance available	2,416.11
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	7,416.11
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	24,000.00

(See Appendix K K 7.)

8. *White River (Lake) Harbor, Michigan.*—The original outlet from White Lake was improved at local expense to about 5 feet. The official project of 1866 increases the depth to 12 feet with an entrance width between piers and revetments of 200 feet. The piers still lack 250 feet and 200 feet, respectively, of their full extension, and the north pier to reach the 15-foot contour in the lake must be built out some 300 feet farther, to prevent the sand accumulations from passing around it and blocking the entrance.

Repeated dredging has been necessary to maintain the navigation, which in fact has never been fully attained to the projected depth.

Considerable repairs, sheet piling, and other measures to maintain the works and prevent shoaling are required.

The expenditures to July 1, 1891, were $256,432.06, and for the fiscal year $6,482.12.

July 1, 1891, balance unexpended	$18,117.94
June 30, 1892, amount expended during fiscal year	6,482.12
July 1, 1892, balance unexpended	11,635.82
July 1, 1892, outstanding liabilities	195.92
July 1, 1892, balance available	11,439.90
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	16,439.90
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	43,225.00

(See Appendix K K 8.)

9. *Muskegon Harbor, Michigan.*—The Muskegon entrance was originally deepened at private cost to about 7 feet. The official project of 1866, amended in 1869, 1873, 1881, and 1884, provided for deepening the navigation to 13 feet, with an entrance width of 300 feet. The revision of 1890 was to close the gap in the north pier, which has been done, and the latest revision of January, 1892, proposes to furnish a 15-foot navigation through from lake to lake.

The expenditures to July 1, 1891, were $284,272.21.

A fair navigation has been maintained, although the services of the dredge were frequently in demand, and at the beginning of the fiscal year the depth was from 15 to 16 feet, but in the fall the channel was very narrow, and the greater part of the space between the piers near their ends was occupied by a shoal with only 11 feet on it. At the earnest solicitation of the harbor interest the Government dredge was kept in commission from October 9 to November 30, 1891, during which period dredging was practicable on eleven days only, and but four of these near the end of the pier. At the opening of navigation in 1892 there was a bare 12½-foot depth close to the south pier, and in April and May the channel was again deepened to 15 feet.

The expenditures for the year were $33,524.32.

In order to close the gap in the north pier 316 feet of the inner north pier was removed by blasting and dredging and a new work built connecting the detached portions. This was completed in October, 1891. Contract was also made for the raising and rebuilding of the sunken outer crib of the north pier. Work was begun in June, 1891, and continued until near the end of September, but in an endeavor to raise the crib it broke in two and was moored for the winter in the inner lake. An amended contract has been made to include the construction of an additional crib outside the restored one, and this work is now in progress.

July 1, 1891, balance unexpended		$44,727.79
June 30, 1892, amount expended during fiscal year		33,524.32
July 1, 1892, balance unexpended		11,203.47
July 1, 1892, outstanding liabilities	$311.23	
July 1, 1892, amount covered by uncompleted contracts	9,640.39	
		9,951.62
July 1, 1892, balance available		1,251.85
Amount appropriated by act approved July 13, 1892		75,000.00
Amount available for fiscal year ending June 30, 1893		76,251.85

(See Appendix K K 9.)

10. Grand Haven Harbor, Michigan.—Grand Haven, in addition to its local commerce, is the principal harbor of refuge on the east coast of Lake Michigan. Originally improved by the construction of a pier on the south side in connection with the steamers operated by the Detroit, Grand Haven and Milwaukee Railway, terminating at that point, the work was taken in hand by the United States in 1866, with extensions projected in 1880 and 1890, with the object of creating an entrance width of 400 feet and a depth of 18 feet in the interest of general commerce. The work has been attended with very beneficial results, but the constant encroachment of sand from the huge dunes lying between the lake and the bend of the stream and which the current transported to the entrance, has in connection with wave action in the lake maintained a bar at the entrance just beyond the ends of the piers, which at times becomes dangerous.

The total expenditures to July 1, 1891, were $565,943.97.

The piers still lack 500 and 300 feet respectively of their full extension, and the sand dunes bordering the entrance to the north should be controlled.

The expenditures for the past year were $38,296.85.

Six new cribs, three on each pier, were completed in October, 1891.

The notable southwest gale of December 4 and 5 nearly wrecked the three new cribs on the south pier. The bed of the lake adjacent to the piers was scoured out to a depth of 11 feet, undermining the pile supports and letting the cribs down. The stone filling of the cribs failed to perform its function of passing through the bottom to fill the excavation made by the scour, and it was not until a week later that the stone was found to have settled through the bottom of the cribs. Fortunately the cribs sunk bodily without capsizing, and having been temporarily strengthened and riprapped for security during the winter, are now in process of restoration by leveling and rebuilding of the superstructure. In addition, contract has been made for the construction of one 100-foot crib on the south pier in accordance with a revised design, intended to meet the possible recurrence of the events of December, and in fact desirable where constructions of this kind are to be placed in circumstances of such exposure in the open lake.

Considerable repairs are becoming urgent to some of the older portions of the revetment.

July 1, 1891, balance unexpended		$58,422.18
June 30, 1892, amount expended during fiscal year		38,296.85
July 1, 1892, balance unexpended		20,125.33
July 1, 1892, outstanding liabilities	$628.59	
July 1, 1892, amount covered by uncompleted contracts	14,058.14	
		14,686.73
July 1, 1892, balance available		5,438.60
Amount appropriated by act approved July 13, 1892		90,000.00
Amount available for fiscal year ending June 30, 1893		95,438.60
Amount (estimated) required for completion of existing project		35,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix K K 10.)

11. Holland (Black Lake) Harbor, Michigan.—The outlet from Holland (Black) Lake was originally improved, at local expense, to some 5 feet depth, and the official project of 1866, amended in 1873, 1879, and 1884, was to provide 12 feet between piers and revetments 200 feet apart. In fact this depth has never been attained in spite of frequent and liberal dredging, the opposing causes being the insufficient projection of the piers, which terminate some 500 feet short of the 15-foot contour in the lake, and the permeability of the revetments to the inflow of sand from the banks.

The entrance was thoroughly dredged to 14 feet in May and July, 1891, and again deepened to 16 feet in August, but on September 13 the depth was 13 feet, and on December 18 was so little as 7 feet. In May, 1892, this was again found to be the depth. It is evident that radical extensions of the project must be made if the navigation is to be maintained.

The expenditure to July 1, 1891, was $267,786.50, and for the fiscal year $4,456.37.

In addition to the dredge work repairs were made to piers and revetments, and sand fences constructed.

July 1, 1891, balance unexpended	$6,827.62
June 30, 1892, amount expended during fiscal year	4,456.37
July 1, 1892, balance unexpended	2,371.25
July 1, 1892, outstanding liabilities	212.55
July 1, 1892, balance available	2,158.70
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	7,158.70

(See Appendix K K 11.)

12. Saugatuck Harbor, Michigan.—The mouth of the Kalamazoo River has a natural depth in ordinary condition of 6 or 7 feet, and the project of 1869, revised in 1875 and 1882, proposed to deepen this to 12 feet and extend the entrance piers into the lake 200 feet apart. The works have never been completed, and are now, for the greater part, in a ruinous condition, while from the immense accessions of sand from the naked waste bordering the river on the north and the absence of proper protection the depth has not been increased to exceed 8 feet, with 10 feet as an exceptional and temporary feature. The river is an outlet for a considerable traffic during the fruit season even with all its disadvantages, but for several years past the Government aid has been confined to dredging when the navigation became entirely obstructed.

The expenditures to July 1, 1891, were $138,981.10, and for the year, $113.55.

July 1, 1891, balance unexpended	$1,458.30
June 30, 1892, amount expended during fiscal year	113.55
July 1, 1892, balance unexpended	1,344.75
July 1, 1892, outstanding liabilities	10.00
July 1, 1892, balance available	1,334.75
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	6,334.75
Amount (estimated) required for completion of existing project	30,260.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix K K 12.)

13. South Haven Harbor, Michigan.—The original improvement of the mouth of Black River was at local expense to secure a width of 85 feet and a depth of 6 or 7 feet.

The official project of 1866, modified in 1869, 1872, and 1888, was to provide a 12-foot navigation, with a width of 180 feet, extending up the river to the highway bridge.

The piers still lack 150 feet and 200 feet, respectively, of their projected extension, and in order to attain their object must in fact be considerably prolonged, as they do not reach beyond the general 10-foot contour in the lake, and the 15-foot contour lies some 300 feet farther out. Measures should also be taken to revet the naked banks of the north side of the stream, and this work should be done, as elsewhere, by the riparian owners or the local authorities.

By use of the dredge a navigation from 10 to 12 feet has been generally maintained.

The total expenditures to July 1, 1891, were $195,101.06, and for the fiscal year $8,771.39.

Considerable repairs and sheet piling to exclude sand were done on the north pier, and the channel was thoroughly dredged last season to 13 and 14 feet, but at the opening of navigation in 1892 the entrance had again shoaled to 10 feet, and further dredging was done to 14 feet in May and June.

Much of the revetments are in need of rebuilding.

July 1, 1891, balance unexpended	$11,898.94
June 30, 1892, amount expended during fiscal year	8,771.39
July 1, 1892, balance unexpended	3,127.55
July 1, 1892, outstanding liabilities	2,217.77
July 1, 1892, balance available	909.78
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	10,909.78
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	40,426.80

(See Appendix K K 13.)

14. St. Joseph Harbor, Michigan.—In its original condition, the entrance to St. Joseph Harbor was a shifting channel of 3 to 7 feet. In 1836, the locality was selected by the Government for improvement as a harbor of refuge, and the project of 1866, as modified in 1874 and 1875, contemplated a navigable depth of 16 feet and width of 270.

The project has never been fully carried out so far as the depth was concerned, the best water attained being 15 feet, which of late years, from accretion of shoals near and outside the entrance and the depressed level of the lake, has averaged not more than 14 feet. During the past year the local conditions became so obstructive as to threaten a practical closing of the entrance and suspension of navigation altogether, as the accumulations of sand behind the north pier had grown to such extent as to overlap it and project directly across the entrance nearly connecting with those on the south side.

Furthermore, these accumulations rose in the open lake nearly a quarter of a mile from the piers, and it was evident that the protecting works are in urgent need of large extensions, if the harbor facilities are to be maintained, and the established lines of lake traffic to continue to do business.

In 1880 the control of the navigation was extended to include the canal, built at private and State cost, which connects Benton Harbor with the lake, and through this 13 feet is to be maintained, the canal having a total width of 100 feet.

Since the construction of the Chicago and West Michigan Railway Bridge in 1870, the harbor has ceased to be one of refuge, and vessels seeking shelter from stress of weather run for other points, but the interior navigation has been fairly well maintained for local commerce, with the aid of considerable dredging, and several transportation lines have been established.

The total expenditure to July 1, 1891, was $263,009.56, and for the past year $9,821.73.

Dredging continued in 1891, until the end of October, at several points between Benton Harbor and the bar, to depths of 13, 15, and 17 feet.

Repairs were made to the more ancient and feeble parts of the works, mainly to prevent inflow of sand to the channel.

Pursuant to renewed complaints of obstruction due to the railway bridge, the Secretary of War directed the company to dredge out and thoroughly clear the draw passages of the bridge, and this work is still in progress.

July 1, 1891, balance unexpended	$11,102.64
June 30, 1892, amount expended during fiscal year	9,821.73
July 1, 1892, balance unexpended	1,280.91
July 1, 1892, outstanding liabilities	632.33
July 1, 1892, balance available	648.58
Amount appropriated by act approved July 13, 1892*	60,000.00
Amount available for fiscal year ending June 30, 1893	60,648.58

(See Appendix K K 14.)

15. St. Joseph River, Michigan.—The improvement in question covers a distance of 25 miles from St. Joseph to Berrien Springs, and this was to be effected by the project of March, 1889, to the extent of securing 3 or 4 feet depth by the removal of snags and bowlders, and the building of small wing dams of cheap construction.

The results have been satisfactory to the limited commerce interested, but are not likely to be permanent without further measures.

The total expenditure to July 1, 1891, was $2,496.82, and for the past year, $953.45.

The river and harbor act approved July 13, 1892, provides that $1,000 of the appropriation for improving St. Joseph Harbor may be expended on St. Joseph River.

July 1, 1891, balance unexpended	$1,003.18
June 30, 1892, amount expended during fiscal year	953.45
July 1, 1892, balance unexpended	49.73

(See Appendix K K 15.)

16. Michigan City Harbor, Indiana.—The works of this harbor consist—

1. Of the improvement of Trail Creek, by entrance piers 100 feet apart, and dredging the creek bed to 13 feet, local authorities and riparian owners attending to the revetment and securing of the banks; and

2. Of extensive pier and breakwater constructions in the open lake. Thus far the outer constructions, constituting the "outer harbor," have been of no practical benefit, owing to the basin being filled with sand, and otherwise unserviceable from exposure to the weight of the north and northwest gales coming through an opening of 400 feet in the outer works. The present and actual harbor of Michigan City is the creek designated officially the "inner harbor."

Outer harbor.—For these works the total expenditures to July 1, 1891, were $678,920.12.

The older portions of the works, inclosing the "basin," are rapidly decaying, and the new "outer breakwater," designed to have a total length of 2,000 feet, is now completed for 500 feet of its length.

The expenditures of the past year were $27,668.83.

The superstructure over the 500 feet of outer breakwater was completed by the construction of 6 courses of timber, after the subsidence of 4 to 6 feet into the lake bed had been leveled up.

---

*Of which $1,000 may be expended on St. Joseph River.

July 1, 1891, balance unexpended	$42,954.88
June 30, 1892, amount expended during fiscal year	27,668.83
July 1, 1892, balance unexpended	15,286.05
July 1, 1892, outstanding liabilities	1,905.71
July 1, 1892, balance available	13,380.34
Amount appropriated by act approved July 13, 1892	30,000.00
Amount available for fiscal year ending June 30, 1893	43,380.34
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	249,613.50

Inner harbor.—The total expenditures to this account to July 1, 1891, were $102,532.49.

The navigation has been practically maintained as projected and gradually extended towards the upper limit by frequent dredging.

The expenditures for the year were $3,390.57.

July 1, 1891, balance unexpended	$6,842.51
June 30, 1892, amount expended during fiscal year	3,390.57
July 1, 1892, balance unexpended	3,451.94
July 1, 1892, outstanding liabilities	1,371.96
July 1, 1892, balance available	2,079.98
Amount appropriated by act approved July 13, 1892	15,000.00
Amount available for fiscal year ending June 30, 1893	17,079.98

(See Appendix K K 16.)

EXAMINATION AND SURVEY, MADE IN COMPLIANCE WITH PROVISIONS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Grand River, Michigan, below Grand Rapids, with a view of determining the existence or nonexistence of underlying rock, the hydraulics of the river, and the detailed topography of the valley subject to overflow*, was made by the local engineer in charge, Major Ludlow, and report thereon submitted through Col. O. M. Poe, Corps of Engineers, Division Engineer, Northwest Division. It is the opinion of Maj. Ludlow and of the division engineer, based upon the facts and reasons given, that this locality is worthy of improvement. This opinion being concurred in by me, Maj. Ludlow was charged with and has completed its survey, and submitted report thereon. The project recommended contemplates improvement of the river to provide for open 10-foot navigation, at an estimated cost of $670,500. The reports were transmitted to Congress and printed as House Ex. Doc. No. 197, Fifty-second Congress, first session. (See also Appendix K K 17.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN EASTERN MICHIGAN.

Officer in charge, Col. O. M. Poe, Corps of Engineers, with Lieut. Charles S. Riché, Corps of Engineers, under his immediate orders.

1. St. Marys River, Michigan.—The project for obtaining a navigable channel of 16 feet depth between Lakes Superior and Huron had been barely completed when the demands of commerce so enormously increased that the work of obtaining a depth of 20 feet throughout was undertaken with the full sanction of both legislative and executive authority.

A necessary part of the project is the construction of a new lock upon the site of the old State locks, to have a length of 800 feet between gates, a width of 100 feet throughout, a depth of 21 feet on the miter sills, and a single lift approximating 18 feet. The canal is to be deepened to correspond. The estimated cost of this enlargement of the canal system is $4,738,865, for the details of which see pages 2220 *et seq.* of the Annual Report of the Chief of Engineers for 1887.

The cofferdam surrounding the site of the lock pit is completed, the pier in front of Fort Brady is completed, and nearly all the necessary material has been filled in behind it. The excavation of the lock pit is finished, and the construction of the masonry walls of the lock is making good progress. Anchorages for the lock gates have been constructed and are being placed in position, and valves and frames for filling and emptying the lock are under contract. Specifications for deepening a portion of the canal have been issued, and proposals for this work will be opened July 2, 1892.

In view of the importance of losing no time in the prosecution of the work, an estimate of $2,000,000 is submitted, as the conditions now existing require that this amount should be available in addition to that already on hand. This entire amount can be expended to advantage during the fiscal year ending June 30, 1894.

Total expenditure to June 30, 1891		$587,676.74
Expended during fiscal year (exclusive of outstanding liabilities)		230,426.64
Total expenditure to June 30, 1892		818,103.38
July 1, 1891, balance unexpended		2,187,335.44
June 30, 1892, amount expended during fiscal year		255,412.19
July 1, 1892, balance unexpended		1,931,923.25
July 1, 1892, outstanding liabilities	$96,080.79	
July 1, 1892, amount covered by uncompleted contracts	1,093,605.47	
		1,189,686.26
July 1, 1892, balance available		742,236.99
Amount (estimated) required for completion of existing project		2,238,865.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		2,000,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix L L 1.)

2. *Operating and care of Saint Marys Falls Canal, Michigan.*—During the fiscal year the canal was open to navigation 233 days. It was closed for the winter December 7, 1891, and opened April 18 for the season of 1892.

Eleven thousand five hundred and fifty-seven vessels, etc., aggregating 9,828,874 registered tons, and carrying 10,107,603 tons of freight and 25,697 passengers, passed through the canal in 5,615 lockages.

The staple articles transported were 2,717,029 tons of coal, 65,667 tons of copper, 4,184,612 barrels of flour, 49,419,131 bushels of grain, 4,142,797 tons of iron ore, 73,047 tons of pig and manufactured iron, 236,169 barrels of salt, 1,330 tons of silver ore, 399,985,000 feet, B. M., of lumber, 38,678 tons of building stone, and 443,212 tons of miscellaneous or unclassified freight.

The estimate of expenditures on account of operating and care for the fiscal year ending June 30, 1893, is $59,000, all of which is provided for by indefinite appropriation.

Total expenditure to June 30, 1891		$316,015.34
Expended during fiscal year, exclusive of liabilities outstanding June 30, 1892		57,870.99
Total expended to June 30, 1892		373,886.33
Amount required for fiscal year ending June 30, 1893		59,000.00
Balance remaining from allotments of preceding year, exclusive of outstanding liabilities	$9,559.01	
Outstanding liabilities June 30, 1892	4,876.53	
		4,682.48
Allotment required for fiscal year ending June 30, 1893		54,317.52

(See Appendix L L 2.)

3. *Dry dock at St. Marys Falls Canal, Michigan.*—The proposition to locate a dry dock in immediate proximity to the lockage system is as objectionable as ever, but if it should be decided to do so, then the location heretofore referred to, at the eastern end of the area transferred from the Fort Brady military reservation to the canal reservation, is the least objectionable.

But the construction of a pier in front of Fort Brady reservation has been completed, and a portion of this work would have to be removed, thus increasing by $20,000, the probable cost of a dry dock, and the estimate therefor should be increased accordingly.

Amount (estimated) required for the construction of a dry dock at the point indicated, $343,872.

It is understood that the State of Michigan holds $65,000 in readiness to transfer to the United States for the purpose of constructing a dry dock at St. Marys Falls Canal.

(See Appendix L L 3.)

4. *Hay Lake Channel, St. Marys River, Michigan.*—Before improvements were commenced the channel through Hay Lake was restricted in depth at Sugar Island Rapids and at Middle Neebish. At these two places a maximum draft of but 8 or 9 feet could be carried if a very irregular course was taken, and, practically, vessels drawing more than 6 feet of water would not attempt the passage. In addition to the places above mentioned there were some shoals in Hay Lake requiring removal to make the channel available for the vessels navigating St. Marys River.

The original estimates for this improvement were based upon a project for a channel 300 feet wide and 17 feet deep, leaving the present navigable channel of St. Marys River at Sugar Island Rapids (about 2½ miles below the canal), through those into Hay Lake, and then by way of Middle Neebish, rejoining the present navigable channel at the foot of Sugar Island, thus saving a distance of 11 miles and obtaining a route which can be so marked by lights as to be navigable at night, a condition impracticable with the present channel, except by the use of many lights.

The estimated cost of this project was $2,127,292. The project was subsequently modified to increase the navigable depth to 20 feet, the estimated cost being $2,659,115, subject to change, however, in case unexpected difficulties are developed during the progress of the work.

Prior to the beginning of work under the contracts now in force, 611,907.17 cubic yards, bank measure, had been excavated from the channel. Under the six contracts for excavation now in force, a total of 1,123,479 cubic yards, bank measure, has been removed, of which 1,061,731 cubic yards was removed during the fiscal year; and work is still in progress. The total so far removed is in excess of that required by the specifications.

The estimate for the work is $2,659,115, of which $1,790,000 has been appropriated, leaving $869,115 to be provided for. To pay the various Government employés and contractors, $500,000 will be required for the fiscal year ending June 30, 1894. This amount should be appropriated with the proviso that any portion of it not required for Hay Lake Channel could be expended elsewhere between Lakes Superior and Huron at places where excavation is needed to attain the navigable depth of 20 feet. This entire amount can be expended to advantage during the fiscal year ending June 30, 1894.

Total expenditure to June 30, 1891		$828,823.08
Expended during fiscal year (exclusive of outstanding liabilities)		280,983.01
Total expenditure to June 30, 1892		1,109,806.09
July 1, 1891, balance unexpended		849,695.80
June 30, 1892, amount expended during fiscal year		284,370.24
July 1, 1892, balance unexpended		565,325.56
July 1, 1892, outstanding liabilities	$84,820.07	
July 1, 1892, amount covered by uncompleted contracts	480,505.49	
		565,325.56
Amount appropriated by act approved August 5, 1892		115,000.00
Amount (estimated) required for completion of existing project		869,115.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix L L 4.)

5. *Harbor at Cheboygan, Michigan.*—Prior to undertaking any improvement at this harbor, only 6½ to 7 feet of water could be carried across the bar at the mouth of Cheboygan River.

The original project for the improvement, adopted in 1871, contemplated dredging a channel 200 feet wide and 14 feet deep through the bar, and revetting each side by a pile pier. Experience gained during the progress of the work already done leads to the belief that the piers can be omitted, with consequent reduction of cost to the extent of about one-half the original estimate.

Subsequent modifications of the project were made until, as it finally stood, it provided for a channel of 15 feet in depth, and generally 200 feet in width from the 15-foot curve in the Straits of Mackinac to the State Road Bridge.

This has been completed, and until the dredged channel begins to silt up, or the revetting piers contemplated in the original project of 1871 are shown to be necessary, no further work is proposed.

Total expenditure to June 30, 1891	$129,706.03
Expended during fiscal year	12.70
Total expenditure to June 30, 1892	129,718.73
July 1, 1891, balance unexpended	18,340.43
June 30, 1892, amount expended during fiscal year	12.70
July 1, 1892, balance unexpended	18,327.73

(See Appendix L L 5.)

6. *Harbor at Thunder Bay, Michigan.*—Prior to the commencement of improvements there was a navigable channel from Thunder Bay into the river of 12 feet depth and of a variable width, which at one place was only 50 feet. The original project for the improvement of the harbor was adopted in 1876, and provided for an entrance channel from the bay into the river, of navigable width, and of not less than 13 feet depth, a subsequent modification increasing the proposed depth to 14 feet.

The work was practically completed in 1884, but it was then stated that the improvement was of such a character that it would require attention from time to time, and it was recommended that a sufficient appropriation be made to render $10,000 available for use when it should be wanted.

On June 30, 1891, a channel about 150 feet wide and 14 feet deep extended across the bar, and dredging to restore the 14-foot channel in accordance with the river and harbor act of September 19, 1890, was still in progress. Work was continued until October 20, 1891, by which time the 14-foot channel was restored for a width of 250 feet entirely across the bar; one dredge cut 16 feet deep and 20 feet wide also extended entirely across the bar, and two adjacent dredge cuts of same depth were partially finished.

In order that the depth of 16 feet obtained in the river may be rendered available, the next appropriation should be expended in deepening the channel across the bar to the full depth of 16 feet for a suitable width.

Total expenditure to June 30, 1891	$20,785.81
Expended during fiscal year	3,403.69
Total expenditure to June 30, 1892	24,189.50
July 1, 1891, balance unexpended	5,372.50
June 30, 1892, amount expended during fiscal year	4,548.87
July 1, 1892, balance unexpended	823.63
Amount (estimated) required for completion of combined projects for Thunder Bay River and Harbor	10,587.48
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L L 6.)

7. *Thunder Bay River, Michigan.*—Before improvements were commenced, Thunder Bay River from its mouth to 1 mile above varied in width from 175 to 100 feet, and had a navigable channel of from 14 to 11 feet deep except at the upper end, where the depth diminished to 5 feet.

The general project for the improvement of the river contemplates a channel 16 feet deep within the dock lines established by the city engineer of Alpena, Mich., in 1888, the width varying from 100 to 50 feet according to locality, and the channel extending from the mouth of the river to a point 1 mile above.

On June 30, 1891, one dredge cut about 25 feet wide and 16 feet deep extended upon the northerly side of the axis of the river from the lighthouse crib at the mouth to the Second Street Swing Bridge in Alpena; a second dredge cut had been made upon the southerly side of the axis for about half this distance, and dredging was still in progress. Work was continued until November 24, 1891, when the contract was closed, and a channel 16 feet deep and from 100 to 50 feet wide extended from the mouth of the river to a point about seven-eighths of a mile above. At this point bed rock was struck, and the cost of further extending the channel will be too great to be warranted by the possible benefits to be derived from so doing.

In order that the depth of 16 feet obtained in the river may be rendered available, the next appropriation should be expended in deepening the channel across the bar at its mouth to the full depth of 16 feet for a suitable width.

Total expenditure to June 30, 1891	$1,724.10
Expended during fiscal year	6,996.20
Total expenditure to June 30, 1892	8,720.30
July 1, 1891, balance unexpended	9,608.50
June 30, 1892, amount expended during fiscal year	8,328.80
July 1, 1892, balance unexpended	1,279.70
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	11,279.70

NOTE.—The estimate of the amount required for completion of the combined projects for improving Thunder Bay River and Harbor is given in the money statement for Thunder Bay Harbor, Michigan, page 335.

(See Appendix L L 7.)

8. *Harbor at Au Sable, Michigan.*—Before the beginning of improvements the mouth of Au Sable River was 150 feet wide, with a depth of 5 feet over the bar. Above the mouth for a quarter of a mile 7 to 10 feet of water was found, and above this point only 5 or 6 feet.

The present project for the improvement of the harbor was adopted in 1866 and modified in 1879, the object being to obtain a channel of not less than 10 feet in depth for a width of 100 feet from Lake Huron to the State Road Bridge at Au Sable.

The money heretofore expended on this improvement has given temporary results only, and a permanent channel can not be secured except at so great a cost as to be disproportionate to the benefits to be obtained.

Total expenditure to June 30, 1891	$114,786.12
Total expenditure to June 30, 1892	114,786.12
July 1, 1891, balance unexpended	200.55
June 30, 1892, amount expended during fiscal year	4.05
July 1, 1892, balance unexpended	196.50

(See Appendix L L 8.)

9. *Saginaw River, Michigan.*—Before the improvements were begun the entrance to Saginaw River was obstructed by a bar in Saginaw Bay about a mile from the shore and a half mile in width between the 10-foot curves, with a minimum depth of about 9 feet. Between the mouth of the river and Bay City, a distance of about 5 miles, the depth varied from 15 to 30 feet. Thence to the head of the river, a further distance of about 16 miles, the channel was obstructed by a number of bars having only 7 feet of water upon them, thus limiting the navigable depth to about 7 feet, although the prevailing depth varied between 12 and 20 feet.

The original project for the improvement of the river was adopted in 1866. Various additions were subsequently made to it until 1882, when a board of engineers recommended that a channel be made 200 feet wide, with a depth of 12 feet, thence to the head of the river, a total distance of about 23 miles.

Additions to this project have been made at various times. These provided for the repair, extension, and reconstruction of the revetment confining the Carrollton Channel and for the construction of similar works at the head of Crow Island for the improvement of Zilwaukee Bar.

On June 30, 1891, dredging was in progress on the bar at the mouth of the river and at Zilwaukee Bar. Repairs were being made to the Carrollton revetment and the wing dam was being extended.

During the fiscal year dredging has been continued at the mouth of the river, and is still in progress. Dredging has also been done at Zilwaukee Bar, in the vicinity of Bristol Street Bridge, Saginaw, and in the channel of the river below Melbourne. The burnt superstructure of the Carrollton revetment has been repaired, as well as the wrecked portion of the lower end of the old wing dam at the head of Crow Island; and the latter was extended downstream, terminating upon the west shore of the island.

Owing to the recent low stage of water, a bar at Essexville, near the mouth of the river, has come into special notice. A channel must be dredged across this bar in order to make available the channel contemplated in the project. The cost of this work was not included in the original estimate, nor was the amount necessary to complete the West Channel along West Bay City.

The amount of material yet to be removed in order to complete the projected channel is estimated at about 640,000 cubic yards, and the cost at $281,203. But it is perfectly well understood that considerable portions of the work can never be considered as permanently completed, and that more or less dredging will always be required after each spring freshet, at a probable cost of not less than $5,000 per year.

Total expenditure to June 30, 1891		$503,331.78
Expended during fiscal year, exclusive of outstanding liabilities		52,326.00
Total expenditure to June 30, 1892		555,657.78
July 1, 1891, balance unexpended		73,727.42
June 30, 1892, amount expended during fiscal year		61,109.73
July 1, 1892, balance unexpended		12,617.69
July 1, 1892, outstanding liabilities	$8,310.45	
July 1, 1892, amount covered by uncompleted contracts	3,352.50	
		11,662.95
July 1, 1892, balance available		954.74
Amount appropriated by act approved July 13, 1892		100,000.00
Amount available for fiscal year ending June 30, 1893		100,954.74
Amount (estimated) required for completion of existing project		68,250.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix L L 9.)

10. Harbor of refuge at Sand Beach, Lake Huron, Michigan.—Prior to 1876 vessels, when caught in heavy weather near the dangerous Pointe aux Barques, the southerly headland of the mouth of Saginaw Bay, were compelled to run a distance of 60 miles and find refuge in St. Clair River. After the subsidence of the storm those upward bound had to work their way back again.

The project for the construction of a harbor of refuge at Sand Beach was adopted in 1873, and consisted of a breakwater constructed of timber cribs filled with stone, inclosing an area which is to be deepened by dredging where necessary.

The estimate of the probable cost of the improvement was $1,442,500. The sum of $1,155,000 has been appropriated for the work, and it was practically completed in 1885, at a cost of about $975,000. Few improvements have resulted in greater benefit to the lake commerce, as is fully shown by the infrequency of disasters in the vicinity since it became available.

The dredging in progress on June 30, 1891, has been continued throughout the fiscal year, interrupted only by the winter. On June 30, 1892, this work was stopped and the dredge discharged, as the limit of the funds assigned for this purpose under the contract had then been reached. The work done consisted in removing shoals in and around the harbor, the material excavated being composed of hard clay, bowlders, and sandstone bedrock, very similar in character to grindstone. All the dredging contemplated for the fiscal year was completed, except upon a shoal at the main entrance to the harbor, and six additional dredge cuts were made across this.

Repairs to the piers were made by a diver during 1891, prior to October 1. In May, 1892, the diver made a thorough examination of the pier foundations and found the damage done during the winter less than usual. On June 1, 1892, the diver began repairing this damage, and this work was still in progress at the close of the fiscal year.

The original project for the harbor has been practically completed, except the superstructure on the south pier, and the dredging, and it is thought that the former will not prove necessary. The dredging, though practically completed as far as the original project is concerned, may be continued to advantage.

The west pier now appears to be in a less satisfactory condition than the others, and extensive repairs must soon be made to the portion above water. The timbers are badly decayed, and the whole superstructure will have to be rebuilt with timber or replaced by more durable material.

The piers were begun in 1873, and age and decay have injured many of the timbers that are above water. There is no doubt that the superstructure will continue to suffer more and more each succeeding year and that the annual cost of repair will steadily increase.

As is well known, this harbor has but little local importance, but is of incalculable benefit to the general commerce of the lakes.

Total expenditure to June 30, 1891	$1,091,812.26
Expended during fiscal year (exclusive of outstanding liabilities)	14,256.34
Total expenditure to June 30, 1892	1,106,068.60
July 1, 1891, balance unexpended	59,673.51
June 30, 1892, amount expended during fiscal year	15,511.88
July 1, 1892, balance unexpended	44,161.63
July 1, 1892, outstanding liabilities	3,778.42
July 1, 1892, balance available	40,383.21
Amount appropriated by act approved July 13, 1892	150,000.00
Amount available for fiscal year ending June 30, 1893	190,383.21
Amount (estimated) required for completion of existing project	80,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L L 10.)

11. Black River, Michigan, at Port Huron.—Before improvements were commenced the lower reach of Black River from its mouth to the Grand Trunk Railroad Bridge, a length of nearly 1½ miles, varied in width from 120 to 150 feet, and had a navigable channel of from 10 to 14 feet in depth, except at a few points, where it was obstructed by shoals or bars having only 8½ feet of water over them.

The original estimate for the improvement of the river to a depth of 15 feet was $55,110. The river and harbor act of September 19, 1890, in appropriating for this improvement required a depth of 16 feet. The estimate had, therefore, to be increased to $75,000. The project upon which this latter estimate was based contemplates excavating a channel 16 feet deep from the mouth of the river to the Grand Trunk Railroad Bridge, the width varying from 160 to 75 feet, according to locality.

On June 30, 1891, a channel 16 feet deep and 75 feet wide extended from the mouth of the river to Military Street Bridge, and dredging was still in progress. Except for interruption by the winter, work has been continued throughout the fiscal year, and is not yet completed. June 30, 1892, a channel 16 feet deep and 75 feet wide extended from the mouth of the river to Military Street Bridge, a distance of about 1,700 feet. Thence for a further distance of about 4,500 feet there was a channel 50 feet wide and of the same depth. The total length of the improved channel was about 6,200 feet.

Total expenditure on project to June 30, 1891		$2,399.11
Expended during fiscal year (inclusive of outstanding liabilities)		10,536.27
Total expenditure to June 30, 1892		12,935.38
July 1, 1891, balance unexpended		23,831.23
June 30, 1892, amount expended during fiscal year		9,456.73
July 1, 1892, balance unexpended		14,374.50
July 1, 1892, outstanding liabilities	$2,309.88	
July 1, 1892, amount covered by uncompleted contracts	12,064.62	
		14,374.50
Amount appropriated by act approved July 13, 1892		10,000.00
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		40,000.00

(See Appendix L L 11.)

12. Mouth of Black River, Michigan.—Black River empties into St. Clair River at Port Huron, Mich. At and below its mouth, extending beyond the middle of St. Clair River, there is a bar or middle ground which was dredged by the Government, under former appropriations, to a clear depth of 15 feet. The main channel of St. Clair River is found between the middle ground and the Canadian shore.

By the deposit of material brought down by the current of Black River, the depth of this bar has been reduced an average of about 6 inches, and in conjunction with a low stage of water has become an impediment to navigation along the front of the city in the vicinity of the mouth of Black River.

The approved project for the improvement of this bar contemplates making a series of dredge cuts of a uniform depth of 16 feet along the dock front of Port Huron, from the 16-foot curve above to the same curve below the mouth of Black River, the first cut at a distance of about 50 feet from the wharves and the others to continue the work outward as far as the available funds will permit.

By June 30, 1891, a channel of 16 feet clear depth extended from the

16-foot curve above the mouth of the river to the same curve below, and from a line parallel to the wharves and 50 feet outside of them towards the middle of St. Clair River, making the improved channel 550 feet wide, its total length being 2,200 feet. Work was still in progress.

Work was continued until the funds were exhausted on November 14, 1891, when the improved channel had been extended 170 feet farther towards the middle of the St. Clair River, making its total width 720 feet.

Total expenditure to June 30, 1891	$12,868.23
Expended during fiscal year (inclusive of outstanding liabilities)	6,939.05
Total expenditure to June 30, 1892	19,807.28
July 1, 1891, balance unexpended	9,259.47
June 30, 1892, amount expended during fiscal year	9,066.75
July 1, 1892, balance unexpended	192.72
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	10,192.72

(See Appendix L L 12.)

13. *St. Clair Flats Canal, Michigan.*—The present approved project for the improvement of the canal contemplates driving a double row of sheet piling to a depth of 26 feet along the channel face of each dike, dredging the area between the dikes to a depth of 20 feet, continuing the channel above and below the canal to the same depth in river and lake, and rebuilding the decayed portions of the timber superstructure. It is considered sufficient to obtain the depth of 18 feet at present, and to postpone obtaining the depth of 20 feet until the general project for a continuous depth of 20 feet along the entire water route shall have reached a more advanced stage. The estimated cost of obtaining these two depths is as follows:

For 18 feet	$365,000.00
For 20 feet	513,559.40

On June 30, 1891, a channel 18 feet in clear depth and 150 feet in width extended from the 18-foot curve in St. Clair River, about 900 feet above the canal, down into the canal for a total length of about 3,890 feet, the decayed channel occupying the east half of the northern part of the canal. A little over 3,000 linear feet of sheet piling remained to be done to complete the revetment and work was still in progress.

During the fiscal year dredging has been continued and is still in progress, and revetment construction has been completed.

On June 30, 1892, a channel 18 feet in clear depth extended from the 18-foot curve in St. Clair River, about 900 feet above the canal, for the full width of the canal (about 300 feet) and throughout its whole length, and for a farther distance of 2,400 feet below the canal, where its width was gradually increased to 380 feet. A double row of sheet piling had been driven to a depth of 26 feet along the channel face of each dike.

The general project for a continuous depth of 20 feet along the entire water route is not yet in a sufficiently advanced stage to warrant making this depth at St. Clair Flats Canal at present, but the depth of 18 feet is urgently demanded. All through commerce between Lakes Ontario and Erie and Detroit River, on the one hand, and Lakes Huron, Michigan, and Superior, on the other, must pass through this canal. This commerce is about the same as that through Detroit River, which, for the season of 1891, consisted of 34,251 vessels, having a registered tonnage of 22,160,000.

Total expenditure to June 30, 1891		$696,179.50
Expended during fiscal year, exclusive of outstanding liabilities		53,581.40
Total expenditure to June 30, 1892		749,760.90
July 1, 1891, balance unexpended		78,981.21
June 30, 1892, amount expended during fiscal year		63,932.11
July 1, 1892, balance unexpended		15,049.10
July 1, 1892, outstanding liabilities	$7,940.88	
July 1, 1892, amount covered by uncompleted contracts	3,264.17	
		11,205.05
July 1, 1892, balance available, applicable only to Grosse Pointe Channel.		3,844.05
Amount (estimated) required for completion of existing project		196,250.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix L L 13.)

14. Operating and care of St. Clair Flats Canal, Michigan.—The canal is in immediate charge of a custodian, who reports any violations of canal regulations, and also acts as inspector whenever work is in progress.

During the spring of 1892 repairs were made to the canal revetments at eleven different places, where they had been injured by the striking of vessels. The cost of this work was $571.16.

During the fiscal year ending June 30, 1892, the ordinary current expenses of operating and care of the canal, such as salary of custodian, trimming willows, etc., exclusive of the amount named above, was $1,188.67.

The estimated cost of operating and care of the canal for the fiscal year ending June 30, 1893, is as follows:

Salary of custodian	$1,500
Current repairs and contingencies which can neither be foreseen nor estimated for in detail, to include a fair proportion of the expenses of the office of the superintending engineer at Detroit	3,500
Total	5,000

All of which is provided for by indefinite appropriation (section 4 of the river and harbor act of June 5, 1884).

Total expenditures to June 30, 1891		$59,253.30
Expended during fiscal year		1,888.67
Total expenditure to June 30, 1892		61,141.97
Amount required for fiscal year ending June 30, 1893		5,000.00
Balance remaining of allotments of preceding year, exclusive of outstanding liabilities	$3,308.33	
Outstanding liabilities	625.00	
		2,683.33
Additional allotment required for fiscal year ending June 30, 1893		2,316.67

(See Appendix L L 14.)

15. Clinton River, Michigan.—In 1870 the channel over the bar at the entrance to this river afforded a depth of only 3½ feet, while the depth in the river for some distance above was 10 feet.

A project for dredging a channel across the bar was approved and carried into effect in 1870. A project for the general improvement of the river from its mouth to the city of Mount Clemens was submitted in 1880 and renewed and approved in 1889. It contemplates a channel 8 feet deep and of navigable width for the entire distance of about 8½ miles from the mouth of the river to Mount Clemens. Involved in this was the closing of a gap opposite Mount Clemens and of Catfish (or Blind) Channel; also closing the main channel at and making a straight cut across Shoemakers Bend, constructing a revetment on the north side of the mouth from the shore to the requisite depth in Lake St. Clair, and dredging wherever necessary to attain the desired depth, the estimated cost of the improvement being $32,926.

By June 30, 1891, the work at Shoemakers Bend had been completed, the gap opposite Mount Clemens had been closed, some dredging had been done at the mouth of the river and at various shoals between there and Mount Clemens, and dredging was still in progress.

Work was continued until the funds were exhausted on October 4, 1891, when a channel 8 feet in depth and 75 feet or more in width extended from the mouth of the river to the bridge at Mount Clemens. Although this channel can not be considered as permanent, no complaint of its deterioration has yet been received.

The good effect of the dredging already done is liable to be destroyed by deposits of material brought down by annual freshets in the river.

Total expenditure to June 30, 1891	$45,405.06
Expended during fiscal year	6,006.54
Total expenditure to June 30, 1892	51,411.60
July 1, 1891, balance unexpended	7,971.49
June 30, 1892, amount expended during fiscal year	7,869.97
July 1, 1892, balance unexpended	101.52
Amount appropriated by act approved July 13, 1892	8,564.00
Amount available for fiscal year ending June 30, 1893	8,665.52

(See Appendix L L 15.)

16. Grosse Pointe Channel, Michigan.—Between the lower end of St. Clair Flats and the deep water of Detroit River the only known obstruction to navigation is the large shoal off Grosse Pointe, known as Grosse Pointe Flats. At ordinary stages of water vessels drawing 16 feet can cross this obstruction, but when the water is as low as it has been during the last few years vessels drawing more than 15 feet can pass only with great care and difficulty.

The river and harbor act of August 11, 1888, appropriated $75,000 for "improving St. Clair Flats Ship Canal, * * * all or any portion of which may, in the discretion of the engineer, be expended in dredging Grosse Pointe Channel." Five thousand dollars was consequently reserved from this appropriation for the removal of any small and well-defined obstruction that might be found at Grosse Pointe, as well as for making such surveys as might be necessary before making a definite project. A small shoal was removed in July, 1889, but no more such obstructions have since been found.

As the improvement of other connecting channels of the Great Lakes begins to approach the 20-foot depth, which it is recognized that they should ultimately have, the annoyance to shipping at Grosse Pointe Flats must increase, and the necessity for a channel at this point is urgent. The number of vessels annually crossing these flats is enormous, and to insure a thoroughly satisfactory result a channel 800 feet wide and nearly 5½ miles long should be dredged and the full depth of 20 feet should be obtained at whatever cost. The approximate estimate for this work is $956,825.76.

The commerce which passes this point already exceeds 20,000,000 tons annually, and steps can not be taken too soon for its accommodation.

July 1, 1891, balance unexpended	$3,844.05
July 1, 1892, balance unexpended	3,844.05
Amount (estimated) required for completion of existing project	956,825.76
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L L 16.)

17. *Rouge River, Michigan.*—Before improvements were begun Rouge River had a channel of 11 feet over the bar at its mouth, and from 10 to 17 feet thence to the bridge of the St. Louis and Wabash Railroad, a distance of nearly 15,000 feet. In earlier days vessels had ascended it to Dearborn, a distance of about 15 miles.

The approved project for improvement contemplates dredging the river to a depth of 16 feet and width of 240 feet at the mouth, gradually narrowing to 100 feet at a distance of about 1,150 feet above, and then continuing this width to the bridge of the St. Louis and Wabash Railroad.

On June 30, 1891, the dredged channel was 16 feet deep, 240 feet wide at the mouth, gradually narrowing to 100 feet at a distance of 1,150 feet above; thence to the Michigan Central Railroad Bridge, an additional distance of about 11,500 feet, it averaged 70 feet in width, being wider at the curves. The total length of the dredged channel was about 12,650 feet.

No funds were available during any part of the fiscal year ending June 30, 1892, for which reason no work was done, and some shoaling has taken place in portions of the channel already dredged.

Total expenditure to June 30, 1891	$20,483.28
Total expenditure to June 30, 1892	20,483.28
July 1, 1891, balance unexpended	133.17
July 1, 1892, balance unexpended	133.17
Amount appropriated by act approved July 13, 1892	11,690.00
Amount available for fiscal year ending June 30, 1893	11,823.17

(See Appendix L L 17.)

18. *Detroit River, Michigan.*—Originally the channel at Lime Kiln Crossing, Detroit River, could not be depended upon for more than 13 feet of water, the ordinary depth being much affected by the direction of the wind. As originally projected in 1874, the improvement at this point was to consist of a curved channel 300 feet wide, with a uniform depth of 20 feet, and the original estimate was based upon this project.

In 1883 it was wisely determined to so modify the project as to secure a straight channel, the least width of which should be 300 feet, with a somewhat greater width at each end, utilizing the work already done.

In 1886 this was further modified to the end that the width of the channel should be increased to 400 feet by removing an additional 100 feet from the western (American) side; and in 1888 a further additional width of 40 feet on the western side was authorized, as the lowest bid under the final appropriation was so low that the money in hand would pay for the increased excavation.

This 440-foot channel was completed during the fiscal year ending June 30, 1891, at a cost of but little more than half the estimate for the 400-foot channel, and the only work done during the fiscal year ending June 30, 1892, has been the preparation of a map of the river front of Detroit, and the reading of water gauges.

The project for Lime Kiln Crossing having been completed, no further estimate is submitted for work at that point. Owing to the low water of the last few years, however, vessels have struck on a number of shoals in different parts of the river, and, in view of the magnitude of the commerce affected, all such shoals should be removed as soon as possible.

Total expenditure to June 30, 1891	$702,122.04
Expended during fiscal year	64.48
Total expenditure to June 30, 1892	702,186.52
July 1, 1891, balance unexpended	988.37
June 30, 1892, amount expended during fiscal year	64.48
July 1, 1892, balance unexpended	923.89
Amount appropriated by act approved July 13, 1892	30,000.00
Amount available for fiscal year ending June 30, 1893	30,923.89
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	20,000.00

(See Appendix L L 18.)

19. *Removing sunken vessels or craft obstructing or endangering navigation.—Wreck of scow Hannah Moore.*—The unladen wooden scow *Hannah Moore* became water-logged and sunk in St. Clair River on July 3, 1891. When it became apparent that her owner did not propose to remove her, the thirty days' notice required by law was published and specifications for her removal were issued.

In due course a contract for her removal was entered into on September 28, 1891, with the lowest bidder, Mr. Chauncey E. Mitchell, for the lump sum of $880. By November 9 the wreck was completely removed, and on November 16 the contract was closed. The total cost to the Government, including superintendence, printing, advertising, etc., was $902.10. No articles of value were recovered.

(See Appendix L L 19.)

IMPROVEMENT OF RIVERS AND HARBORS ON LAKE ERIE WEST OF ERIE, PENNSYLVANIA.

Officers in charge, Maj. L. Cooper Overman, Corps of Engineers, to December 1, 1891, and Lieut. Col. Jared A. Smith, Corps of Engineers, since December 12, 1891, with Lieut. William V. Judson, Corps of Engineers, under their immediate orders; Lieut. William V. Judson, Corps of Engineers, in temporary charge from December 1 to 12, 1891.

1. *Monroe Harbor, Michigan.*—The original project for the improvement of this harbor was adopted in 1835, when Monroe was a town of considerable importance, and when the navigable waters of the River Raisin were separated from the waters of Lake Erie by extensive shoals. It provided for cutting a canal through River Raisin Point, between the

river and the lake, 4,000 feet long and 100 feet wide, and protecting the entrance into the lake by parallel piers, the object being to afford a channel of entrance of navigable width with a depth of 10 feet. Work was commenced in 1835 and has been continued from time to time since that date.

The entire amount appropriated for this harbor has been $225,515.27, all of which has been expended in construction and repairs.

The annual report for 1891 reported that at the close of the previous fiscal year there was a fair channel with a least depth of 8 feet up to a point below Monroe, where the bottom is of rock.

No expenditures have been made during the past year, and there is no further information regarding condition of channel.

The revetment of the canal and the piers are now very much decayed.

Amount appropriated by act approved July 13, 1892	$10,000.00
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	16,000.00

(See Appendix M M 1.)

2. *Toledo Harbor, Ohio.*—The original project provided for making the existing channel 200 feet wide and 12 feet deep through Maumee Bay, and this was amended from time to time, resulting in the present project, which provides for a width of 200 feet at bottom and a depth of 16 feet at low water between the city of Toledo and deep water in Lake Erie.

The total amount appropriated for improving the natural or old channel previous to June 30, 1892, is $724,332.61. Amount expended to June 30, 1891, $719,432.58. Amount expended in last fiscal year, including liabilities, $4,900.03.

The act of September 19, 1890, appropriated $5,000 for clearing old channel. This sum was expended in the summer of 1891 in dredging shoal places. The channel was so far cleared as to leave a depth of 15.6 feet throughout and a width of 100 feet in the narrowest place, the widest being about 260 feet.

As the new straight channel is now open to navigation, and is better than the old one, it does not seem desirable to expend any further sums in maintaining the less direct and poorer channel.

Dredging in straight channel was continued until June 7, 1892, save when suspended for the winter. As a result this channel is now open to navigation with its full width of 200 feet on the bottom over nearly nine-tenths of the distance, and the narrowest portion remaining has a width of 170 feet.

Various causes have contributed to prevent dredging so as to give a clear channel of 17 feet depth, and there has been a fill of eight-tenths of a foot from sediment and other material moved by waves or currents. The average depth below mean level of the lake, referred to mean level from 1860 to 1875, is 15.6 feet.

There is, therefore, considerable dredging still required to complete the channel to full width and depth, and an annual expenditure will be required in future for maintenance of the channel.

The officer in charge of the work recommends that a good dredge and scows be procured and operated by hired labor, as the most economical and advantageous method of maintaining the channel.

The pile protection around the range lights in the turn-out division was completed December 1, 1891.

Old Channel.

July 1, 1891, balance unexpended	$4,900.03
June 30, 1892, amount expended during fiscal year	4,423.66
July 1, 1892, balance unexpended	476.37
July 1, 1892, outstanding liabilities	476.37

Straight Channel.

July 1, 1891, balance unexpended	191,682.54
June 30, 1892, amount expended during fiscal year	176,224.04
July 1, 1892, balance unexpended	15,458.50
July 1, 1892, outstanding liabilities	9,905.89
July 1, 1892, balance available	5,552.61
Amount appropriated by act approved July 13, 1892	200,000.00
Amount available for fiscal year ending June 30, 1893	205,552.61
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	1,200,000.00

(See Appendix M M 2.)

3. *Port Clinton Harbor, Ohio.*—In 1870 the channel at the entrance to this harbor was narrow and intricate, with a depth of only 5 feet.

The present project, adopted in 1875, provides for a pile revetment from the north shore of the Portage River, opposite the town, 967 feet into the lake, and two pile piers 200 feet apart, of an aggregate length of 4,100 feet, extending to the depth of 10 feet in the lake, with a view of maintaining a depth of 9 feet between them.

The total amount appropriated and expended for this harbor to June 30, 1891, was $56,000.

The act of September 19, 1890, appropriated $3,000 for improving this harbor. This sum has been expended in the last fiscal year for dredging to deepen the channel. A depth of 10 feet through the bar and between piers has been restored. Such expenditures for maintaining the depth of water are not a part of the project of improvement for which the estimate is submitted, and the estimate to complete the project is therefore not reduced.

July 1, 1891, balance unexpended	$3,000.00
June 30, 1892, amount expended during fiscal year	3,000.00
Amount appropriated by act approved July 13, 1892	10,000.00
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	27,000.00

(See Appendix M M 3.)

4. *Sandusky City Harbor, Ohio.*—The original depth in the channel through the outer bar was 10 feet and greatest depth in bay about 12 feet.

The project adopted in 1880 provided for a channel through the outer bar and through the bay 200 feet wide, and parallel to the city docks 100 feet wide, the whole to be 15 feet deep.

Approved project of 1888 provides for a "straight channel" for this harbor 200 feet wide and 17 feet deep, extending from the east end of the dock channel to the north end of Cedar Point. This new channel will materially shorten and improve the existing entrance. The estimated cost of straight channel, as projected, is $96,712; of this amount there has already been appropriated, by acts of Congress of 1888 and 1890, the sum of $80,000, more or less.

Act of September 19, 1890, appropriated for improving harbor at Sandusky, Ohio, $45,000. Amount expended, including outstanding liabilities, to June 30, 1891, $315,251.72. Amount of liabilities incurred in last fiscal year $37,739.74.

Dredging in straight channel under contract reported at end of last fiscal year was continued until October 17, when contract was completed.

As nearly as can be determined in advance of a careful survey the present condition of the channel indicates that about one-third of the dredging for new straight channel has been accomplished. A survey of the harbor is to be made at an early day which will afford definite information regarding the condition of the harbor.

Dredging in the old channel to restore full width and depth was completed July 23.

The outer bar is now the worst obstruction, the channel having a depth of only 12 to 14 feet and width of 50 to 100 feet.

The conditions of this harbor are such that a full depth in channels can only be maintained by frequent dredging.

July 1, 1891, balance unexpended	$40,362.20
June 30, 1892, amount expended during fiscal year	38,273.66
July 1, 1892, balance unexpended	2,088.54
Amount appropriated by act approved July 13, 1892	41,712.00
Amount available for fiscal year ending June 30, 1893	43,800.54

(See Appendix M M 4.)

5. *Sandusky River, Ohio.*—The present project for this improvement was based on a survey made in compliance with the river and harbor act of 1880, and provides for opening a channel 100 feet wide and 9 feet deep through the bars between the city of Fremont and the channel in Sandusky Bay.

The expense was estimated to be $44,000.

At the close of the fiscal year ending June 30, 1883, the sum of $21,500 had been appropriated for the present project, all of which has been expended. No further appropriation was made until the year 1890.

Act of September 19, 1890, appropriated for this improvement $1,500.

Dredging under the last appropriation was commenced September 1 and completed September 15, 1891.

As a result the navigation was somewhat improved, so as to fairly meet the present demands of commerce to Fremont. The least depth in channel was 7 feet in September, 1891.

Somewhat more than half the estimated cost of project has been expended, but it is ten years since work was commenced, and it is probable that the amount now required to procure a channel of 9 feet depth would not be decreased to the extent of the amount appropriated.

Amount expended previous to June 30, 1891	$21,500.00
Amount expended in last fiscal year	1,500.00
July 1, 1891, balance unexpended	1,500.00
June 30, 1892, amount expended during fiscal year	1,500.00
Amount appropriated by act approved July 13, 1892	5,000.00
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	16,000.00

(See Appendix M M 5.)

6. ***Huron Harbor**, Ohio.*—The improvement of this harbor was commenced in 1826, when the mouth of the river was closed to navigation

by a sand bar, and has been continued from time to time since that date.

The project adopted in 1890 consists in extending the parallel piers to the lake contour of 16 feet depth and dredging channel to same depth. The estimated cost of this project was $22,000 in addition to amount required for renewing portions of old work.

At the beginning of the fiscal year work was in progress under contract with John Stang, of Lorain, Ohio, for extending west pier 120 feet. The work was completed September 23, 1891. Some minor repairs have also been made to both piers. The project is about one-half completed.

Total expenditures to June 30, 1891, $128,469.43. Expenditures in last fiscal year, $10,804.28.

The result thus far is a channel depth of 16 feet, where originally the bar was dry at low water.

The estimated cost of completing the extension of piers as contemplated, is $13,600. The superstructure of old piers is in very bad condition from decay and injury by storms. The necessary repairs and renewal are estimated to cost $12,000.

Like nearly all the lake harbors the channel outside the piers shoals more or less from year to year, so that it is generally necessary to use a part of available funds in dredging. At times repairs are indispensable, so that part of each appropriation is necessarily expended without a corresponding advance in the project of improvement.

July 1, 1891, balance unexpended	$10,804.28
June 30, 1892, amount expended during fiscal year	10,804.28
Amount appropriated by act approved July 13, 1892	15,000.00
Amount (estimated) required for renewal of piers Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	10,600.00

(See Appendix M M 6.)

7. *Vermillion Harbor, Ohio.*—Before improvement the mouth of the Vermillion River was closed by a sand bar, upon which there was a depth of less than 2 feet. The original project consisted of parallel piers running out into the lake from each side of the mouth of the river, in order to secure a depth of 10 feet. This project has been amended from time to time, and now provides for a depth of 14 feet.

In 1878 the channel was about 70 feet wide, with a depth of about 12 feet, and has since remained nearly permanent.

The act of September 19, 1890, made an appropriation of $2,000 for this harbor for repairs. The amount is much too small to put the piers in good condition.

The most economical and advantageous method of doing the work is by hired labor. It was not convenient to make the repairs at any time during the last fiscal year.

The work will be completed as far as available funds may permit in the season of 1892.

The total amount appropriated for construction and maintenance of this harbor has been	$126,701.28
Total expenditures	124,701.28
July 1, 1891, balance unexpended	2,000.00
July 1, 1892, balance unexpended	2,000.00
Amount appropriated by act approved July 13, 1892	2,000.00
Amount available for fiscal year ending June 30, 1893	4,000.00

Amount (estimated) required for completion of existing project......	$6,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M M 7.)

8. *Black River Harbor, Ohio.*—The original project for the improvement of this harbor was adopted in 1828, and amended from time to time as the demands of commerce called for an increased depth of channel. The present project provides for parallel piers 200 feet apart, running out to a depth of 16 feet in the lake.

The total amount appropriated and allotted for this improvement in various years, commencing with 1828, has been $232,204.77; amount expended to June 30, 1891, $222,928; amount expended in last fiscal year, $9,276.77.

Work of extending the piers under contract previously reported was completed September 12, 1891. Under this contract the east pier has been extended 102 linear feet.

Small repairs have been made to superstructure of old piers.

At the close of the last fiscal year the channel was reported to be 16 feet deep.

July 1, 1891, balance unexpended....................................	$9,276.77
June 30, 1892, amount expended during fiscal year........................	9,276.77
Amount appropriated by act approved July 13, 1892......................	20,000.00
Amount (estimated) required for increase of depth to 17 feet..........	38,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M M 8.)

9. *Cleveland Harbor, Ohio.*—The original project for the improvement of the mouth of Cuyahoga River was adopted in 1825, and has been amended from time to time to gain increased depth. It consists of parallel piers about 200 feet apart, running out to a depth of 16 feet in the lake.

When operations were commenced there was a long, low sand bar where the river now empties into the lake, and the entrance was through a narrow, intricate channel, with a depth of about 3 feet.

The amount appropriated and allotted for the improvement from 1825 to 1874, including survey in 1825, was $346,881.61. In 1876 the sum of $8,000 was appropriated for maintenance of old work.

In 1875 a project was adopted for construction of a breakwater to form a harbor of refuge. The project has been amended from time to time, and now includes two breakwaters, one east and one west of the channel entrance.

From 1875 to 1890 inclusive there was appropriated for continuing the improvement the sum of $1,168,750. Of this amount certain sums have necessarily been expended for repairs of old piers and for dredging to maintain the channel depth. These sums will amount to about $50,000. Assuming this amount to be exact, there had been expended upon the breakwaters for construction and repairs to June 30, 1891, $1,112,399.85; amount expended during last fiscal year, $54,718.40.

As a result, the west breakwater has been completed and about 2,152 feet of the east breakwater, making a total length of 9,308⅓ feet. The amount remaining to complete the breakwater as planned is 3,350 linear feet.

In the last fiscal year the construction of breakwater was continued from July 1 to November 23, when the contract was completed.

Under this contract the east breakwater was extended 452⅓ linear feet.

Dredging in the inner harbor was continued until July 15. At conclusion of the work the channel had a clear depth exceeding 16 feet.

In the spring of 1892 it was found that quite extensive repairs were needed to the breakwaters, owing to injuries by storms and ice. The amount which could be undertaken was limited by available funds. These repairs were commenced in June and were in progress at the close of the fiscal year.

The maintenance of the breakwater already completed will require a considerable annual expenditure, and the same is true of the channel entrance to the river, which is the real commercial harbor of Cleveland.

July 1, 1891, balance unexpended	$56, 350. 15
June 30, 1892, amount expended during fiscal year	54, 718. 40
July 1, 1892, balance unexpended	1, 631. 75
July 1, 1892, outstanding liabilities	233. 87
July 1, 1892, balance available	1, 397. 88
Amount appropriated by act approved July 13, 1892	100, 000. 00
Amount available for fiscal year ending June 30, 1893	101, 397. 88
Amount (estimated) required for completion of existing project	344, 250. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M M 9.)

10. Fairport Harbor, Ohio.—When the work was commenced in 1826 the mouth of the river was closed by a sand bar 1,200 feet wide, at times so hard and dry that teams could cross over it.

The present project for the improvement of this harbor consists of parallel piers, 200 feet apart, running into the lake. It was adopted in 1825, and has been modified by prolonging the piers from time to time so as to give increased depth, the object now being to afford a channel of navigable width and not less than 16 feet in depth.

The total amount appropriated and allotted for Grand River and Fairport Harbor, commencing in 1825, is $320,873.53; amount expended to June 30, 1891, $299,469.82; amount expended in last fiscal year, $20,033.26.

At the beginning of the fiscal year work was in progress under a contract reported last year. The contract expired July 30, 1891, by limitation of time, and was amended.

Proposals were obtained and a new contract was let to Mr. J. R. Irwin, of Painesville, Ohio. Under this contract, dredging was commenced October 5, and completed November 23, 1891. As a result the channel was given a depth of 17 feet throughout.

In the spring of 1892 it was found that a bar had formed near the end of the piers at the entrance to the harbor. As its immediate removal was necessary a dredge, scows, and tug were hired from the American Transportation Company, at a rate of $75 per day for the outfit.

The plant was employed ten and one-half days, and a good channel was dredged through the bar to a depth of 17 feet.

Work under contract for extension of piers was continued until August 31, when it was completed. The west pier has been extended 80 feet and the east pier 120 feet. General repairs have also been made to both piers.

The commerce of Fairport Harbor is increasing rapidly and it seems probable that additional facilities may be required in the near future.

July 1, 1891, balance unexpended	$21,403.71
June 30, 1892, amount expended during fiscal year	20,033.26
July 1, 1892, balance unexpended	1,370.45
Amount appropriated by act approved July 13, 1892	35,000.00
Amount available for fiscal year ending June 30, 1893	36,370.45
Amount (estimated) required for completion of existing project	79,400.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M M 10.)

11. Ashtabula Harbor, Ohio.—The original project for the improvement of this harbor was adopted in 1826. Rock bottom was then found at 9 feet below the surface, and there was a depth of only 2 feet of water on the bar at the entrance.

A later amended project contemplated the extension of the piers out to 16 feet depth of water, the removal of the decayed portions of both piers, and rebuilding with new material, at the same time straightening the line of the west pier so as to afford a uniform width of 160 feet in channel.

The present project, adopted in 1891, provides for a width of 205 feet between piers and a depth in channel between piers of 20 feet; the piers to be extended to the depth of 22 feet in the lake.

Dredging the shale rock and loose material was continued, under contract previously reported, until September 26, when it was completed.

As a result the channel was dredged to a depth varying from 16 to 17 feet, and from 115 to 150 feet in width. The channel through the bar was excavated to a depth of 18 feet.

The work of removing part of east pier has not yet been undertaken, for the reason that the lowest proposal for the work exceeded the amount of available funds.

In the spring of 1892, the channel over the bar was again filled. A dredge was employed 45¾ hours with scows and tug, and the channel was excavated to a depth of 18 feet.

The total amount appropriated for this harbor from 1826 to 1890, inclusive, was $467,401.21; amount expended to June 30, 1891, $428,310.72; amount expended in last fiscal year, including liabilities, $30,423.74.

Ashtabula is rapidly becoming one of the largest shipping points for iron ore upon Lake Erie, and the necessity for deeper water is urgent.

July 1, 1891, balance unexpended	$39,090.49
June 30, 1892, amount expended during fiscal year	30,203.74
July 1, 1892, balance unexpended	8,886.75
July 1, 1892, outstanding liabilities	220.00
July 1, 1892, balance available	8,666.75
Amount appropriated by act approved July 13, 1892	70,000.00
Amount available for fiscal year ending June 30, 1893	78,666.75
Amount (estimated) required for completion of existing project	244,392.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M M 11.)

12. Removing sunken vessels or craft obstructing or endangering navigation.—Two wrecks in Port Clinton Harbor, Ohio, one of the sail boat *Rescue*, the other of the tug *Wilcox*, have been examined and found to be obstructions to navigation, and an allotment of $100 from the permanent appropriation of June 14, 1880, was made for their removal by the Secretary of War May 17, 1892. The work was not done before the close of the fiscal year.

(See Appendix M M 12.)

EXAMINATIONS AND SURVEYS, MADE IN COMPLIANCE WITH PROVISIONS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Maj. Overman, and reports thereon submitted through Col. Henry L. Abbot, Corps of Engineers, Division Engineer, Northeast Division. It is the opinion of Maj. Overman and of the division engineer, based upon the facts and reasons given, that these localities are worthy of improvement. The conclusions of these officers being concurred in by me, Maj. Overman was charged with and has completed their survey and submitted reports thereon. The reports were transmitted to Congress and printed as executive documents of the Fifty-second Congress, first session.

1. Grand River, Ohio, between Richmond and the mouth.—The improvement proposed contemplates the excavation of a channel 160 feet wide, 18 feet deep, and 7,310 feet long, at an estimated cost of $39,000. Printed as House Ex. Doc. No. 61. (See also Appendix M M 13).

2. Conneaut Harbor, Ohio.—Maj. Overman recommends the construction of new piers and dredging between them to a depth of 17 feet, the estimated cost of which is as follows:

Construction of two piers, about 2,000 feet long, to the 17-foot depth in the lake	$300,000
Dredging new channel 17 feet deep, 160 feet wide at bottom, and about 2,100 feet long, to the 17-foot depth in the lake	51,600
Revetment of the shore inside for 500 feet on the west side and 700 feet on the east side	12,000
Contingencies	54,540
Total	418,140

Printed as House Ex. Doc. No. 42. (See also Appendix M M 14.)

IMPROVEMENT OF ERIE HARBOR, PENNSYLVANIA, AND OF DUNKIRK, BUFFALO, WILSON, OLCOTT, AND OAK ORCHARD HARBORS, AND OF TONAWANDA HARBOR AND NIAGARA RIVER, NEW YORK.

Officer in charge, Maj. Amos Stickney, Corps of Engineers, to January 25, 1892, and Maj. E. H. Ruffner, Corps of Engineers, since that date; Division Engineer, Col. Henry L. Abbot, Corps of Engineers.

1. Erie Harbor, Pennsylvania.—The original survey of this harbor was made in 1819, at which time the channel was narrow and tortuous, with a depth of only 6 feet. In 1823 a plan for the improvement was adopted, and constitutes the present work at the entrance to the harbor, excepting some changes which have been required, either on account of the age of the structures already built or other causes. The piers have been extended from time to time and are now in pretty good order and condition. The north pier needs considerable repairs.

The present project contemplated the extension of the piers to the 16-foot curve in the lake and the maintenance of a channel of navigable width 16 feet in depth from the harbor inside to the lake outside.

Operations have been prosecuted with more or less interruption and suspension (no work was done from 1838 to 1842, from 1846 to 1853, and from 1855 to 1864), and have resulted in much benefit to the harbor and its channel entrance. The work during the year consisted in minor repairs to the piers, dredging in channel, which has put it in excellent condition, and extending the north pier 450 feet.

The total amount expended up to June 30, 1891, not including outstanding liabilities, was $761,761.10. The amount expended during the fiscal year ending June 30, 1892, was $37,131.23.

July 1, 1891, balance unexpended	$70,106.13
Received from sales of material	4,716.89
	74,823.02
June 30, 1892, amount expended during fiscal year	37,131.23
July 1, 1892, balance unexpended	37,691.79
July 1, 1892, outstanding liabilities	504.00
July 1, 1892, balance available (includes $20,000 reserved for Presque Isle).	37,187.79
Amount appropriated by act approved July 13, 1892	40,000.00
Amount available for fiscal year ending June 30, 1893	77,187.79

(See Appendix N N 1.)

2. *Preservation and protection of Presque Isle Peninsula, Erie Harbor, Pennsylvania.*—In a report upon the examination of Erie Harbor, made in 1885, it was recommended that the neck of the peninsula be protected by a breakwater, and the movement of sand around the eastern end of the peninsula, which threatens to close the harbor entrance, be arrested by the construction of jetties perpendicular to the shore of the peninsula, at an estimated cost of $173,044.50.

Work under this project was in progress until October, 1889, when it was abandoned, it having been found that the structures built would not stand against the violence of the storms. No further work is at present contemplated, but the sum of $20,000 has been reserved from the appropriation for the improvement of Erie Harbor, to be used in case of necessity in closing any breach which might occur.

The total amount expended up to June 30, 1890, was $60,000. Nothing was expended during the fiscal year ending June 30, 1892.

(See Appendix N N 2.)

3. *Dunkirk Harbor, New York.*—The improvement of this harbor was commenced in 1827, when the first appropriation therefor was made. The original project was much the same as that of the existing improvement, which comprises the formation of an artificial harbor in front of the city by means of a breakwater running nearly parallel with the shore, and a shore arm or pier to the westward, with an opening between the piers and the breakwater. By 1832 the sum of $28,489.84 had been expended on the original plan, and the breakwater was then 2,564 feet long and the pier 1,400 feet long.

Various improvements and repairs were made from time to time, and by 1838 there had been completed 2,125 feet of breakwater and

300 feet of detached breakwater. In 1848 the breakwater was demolished.

Between 1848 and 1870 some portions of the work were renewed and others repaired, but in 1870 a Board of Engineers took into consideration the question of the radical improvement of the harbor. The Board recommended a plan which provided a breakwater 2,860 feet long, one part of which, 2,300 feet in length, was to be nearly parallel with the shore, the other part to be nearly parallel to the axis of the channel entrance, 560 feet long, and terminating at the position of the dumb beacon, and the formation of a channel 170 feet wide and 13 feet deep; of the 2,300-foot section, 1,341 feet has been completed; none of the 560-foot section has been built.

Work during the year consisted in repairing parts of the breakwater and west pier. The superstructures of the breakwater and pier are in very bad condition and need rebuilding. The channel requires considerable rock excavation and dredging to make it 170 feet wide as proposed.

The total amount expended up to June 30, 1891, not including outstanding liabilities, was $493,153.05. The amount expended during the fiscal year ending June 30, 1892, was $6,864.93.

July 1, 1891, balance unexpended	$20,926.33
June 30, 1892, amount expended during fiscal year	6,864.93
July 1, 1892, balance unexpended	14,061.40
July 1, 1892, outstanding liabilities	7.00
July 1, 1892, balance available	14,054.40
Amount appropriated by act approved July 13, 1892	20,000.00
Amount available for fiscal year ending June 30, 1893	34,054.40
Amount (estimated) required for completion of existing project	128,116.41
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N N 3.)

4. *Buffalo Harbor, New York.*—The original project for the improvement of this harbor was adopted in 1826, and, as modified at various times, provided for the construction of piers on the north and south sides of Buffalo Creek, a masonry sea wall running south from the inshore end of the south pier, and a breakwater less than half a mile in front of the light-house, its long arm being nearly parallel with the shore.

The present project was adopted in 1874, and provided for the construction of a breakwater of crib work 7,600 feet long, running parallel with the shore, and a shore arm of piles and crib work, 4,100 feet long, running out toward the southern end of the main or detached breakwater, leaving an opening of 150 feet between them.

In 1887 this project was amended so that in the reconstruction of superstructure concrete was substituted for timber crib work.

During the past year the principal work has consisted in rebuilding about 1,970 feet of superstructure in concrete, and in extending main breakwater 450 feet south, and in minor repairs to structures. Total amount expended up to June 30,1891, not including outstanding liabilities, was $2,222,162.99. The amount expended during the fiscal year ending June 30, 1892, was $230,604.08.

July 1, 1891, balance unexpended	$269,317.42
Amount received for cost of repair of damage to work	173,95
Repayment	16.70
	269,508.07
June 30, 1892, amount expended during fiscal year	230,604.08
July 1, 1892, balance unexpended	38,903.99
July 1, 1892, outstanding liabilities	15.00
July 1, 1892, balance available	38,888.99
Amount appropriated by act approved July 13, 1892	300,000.00
Amount available for fiscal year ending June 30, 1893	338,888.99
Amounted (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	146,223.17

(See Appendix N N 4.)

5. *Tonawanda Harbor and Niagara River, New York.*—The project for this work contemplates a channel 18 feet deep and 400 feet wide from the mouth of the Niagara River at Lake Erie to the north end of Tonawanda Harbor, New York. The work of the year has consisted in excavating 28,764 cubic yards of rock, sand, clay, and gravel from the channel near Strawberry Island, which provides a fair channel 200 feet wide through the reef at this point. The amount expended up to June 30, 1891, was, not including outstanding liabilities, $105,464.75. The amount expended during the fiscal year ending June 30, 1892, was $40,392.86.

July 1, 1891, balance unexpended		$69,535.25
June 30, 1892, amount expended during fiscal year		40,392.86
July 1, 1892, balance unexpended		29,142.39
July 1, 1892, outstanding liabilities	$1,910.00	
July 1, 1892, amount covered by uncompleted contracts	25,000.00	
		26,910.00
July 1, 1892, balance available		2,232.39
Amount appropriated by act approved July 13, 1892		75,000.00
Amount available for fiscal year ending June 30, 1893		77,232.39
Amount (estimated) required for completion of existing project. Submitted in compliance with the requirements of sections 2 of river and harbor acts of 1866 and 1867.		1,008,690.16

(See Appendix N N 5.)

6. *Wilson Harbor, New York.*—The project for the improvement of this harbor was adopted in 1873 and modified in 1877, the object being to afford a channel of navigable width and 12 feet in depth by the extension of parallel piers from the mouth of Twelve Mile Creek to the 12-foot curve in Lake Ontario, with the formation of a protected channel between the piers. The mouth of the creek was originally obstructed by a bar, upon which there was a depth of 1 foot. Before the commencement of operations by the United States the piers had been carried about 400 feet into the lake by private enterprise.

The total amount expended to June 30, 1891, was $64,899.75. The amount expended during the fiscal year ending June 30, 1892, was $78.76.

July 1, 1891, balance unexpended	$100.25
June 30, 1892, amount expended during fiscal year	78.76
July 1, 1892, balance unexpended	21.49

Amount (estimated) required for completion of existing project	$13,978.49
Amount required for repairs to existing works	13,364.20
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N N 6.)

7. *Olcott Harbor, New York.*—The project for the improvement of this harbor was adopted in 1866. It proposes to connect the deep water in Lake Ontario with the deep water in Eighteen Mile Creek by the extension of two parallel piers from the mouth of the creek to the 11-foot curve in the lake, with the addition of a dredged channel between the piers. The project was modified in 1874 and in 1881 to provide for the removal of rock found in the channel between the piers and for additional pier extension. The natural channel between the mouth of the creek and the lake was obstructed by a bar, upon which there was a depth of 1½ feet. The final project, adopted June 18, 1891, definitely fixes the length of the piers at 850 and 873 feet respectively, and provides for a channel 180 feet wide between piers, decreasing in width to 98 feet at the Main Street Bridge crossing Eighteen Mile Creek, with a depth of 13.5 feet at mean lake level. During the year the work of thoroughly repairing the piers was finished and the channel completed. The total amount expended up to June 30, 1891, not including outstanding liabilities, was $132,703.06. The amount expended during the fiscal year ending June 30, 1892, was $24,800.71.

July 1, 1891, balance unexpended	$30,296.94
June 30, 1892, amount expended during fiscal year	24,800.71
July 1, 1892, balance unexpended	5,496.23
July 1, 1892, outstanding liabilities	17.00
July 1, 1892, balance available	5,479.23

(See Appendix N N 7.)

8. *Oak Orchard Harbor, New York.*—The earliest project for the improvement of this harbor was adopted in 1836, the date of the first appropriation, and proposed the construction of an east and west breakwater approaching to within 200 feet of each other, and connecting at the opening with two parallel piers extending into the lake.

Subsequent modifications were extensions to the original project to provide for removal of rock and to adjust the harbor to the increased demand of commerce. The present project was adopted in 1881, the object being to extend the piers to the 12-foot curve in the lake, with the formation of a channel of navigable width and 12 feet deep at low water between the piers. The natural entrance into Oak Orchard Creek was narrow, with a depth of 2 to 4 feet.

A shore protection 91 feet long was built in 1888 to the east of the east pier. During the past year the channel between the piers was widened and deepened. The total amount expended up to June 30, 1891, not including outstanding liabilities, was $199,514.21. The amount expended during the fiscal year ending June 30, 1892, was $4,963.45.

July 1, 1891, balance unexpended	$5,485.79
June 30, 1892, amount expended during fiscal year	4,963.45
July 1, 1892, balance unexpended	522.34
July 1, 1892, outstanding liabilities	8.50
July 1, 1892, balance available	513.84

(See Appendix N N 8.)

EXAMINATION AND SURVEY, MADE IN COMPLIANCE WITH PROVISIONS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Port Day, above Niagara Falls, New York*, was made by the local engineer in charge, Maj. Stickney, and report thereon submitted through Col. Henry L. Abbot, Corps of Engineers, Division Engineer, Northeast Division. It is the opinion of Maj. Stickney, and of the division engineer, based upon the facts and reasons given, that this locality is worthy of improvement. This opinion being concurred in by me, Maj. Stickney was charged with and has completed its survey and submitted report thereon. The improvement proposed contemplates forming a channel 300 feet wide from Tonawanda down to Conners Island, 200 feet wide from Conners Island to Grass Island, and increasing from 200 to 400 feet wide from Grass Island to Port Day; and construction of an embankment, from rock excavated from the channel, extending from Conners Island to Port Day so as to inclose the lower end of the channel. Maj. Stickney recommends that, if the improvement of this part of the river should be undertaken, a channel of 8 feet depth be first provided, which could be enlarged as an increase of commerce might demand. The estimated cost of the work proposed, viz, channel 8 feet deep at mean lake level, is $257,829. The reports were transmitted to Congress and printed as House Ex. Doc. No. 67, Fifty-second Congress, first session. (See also Appendix N N 9.)

IMPROVEMENT OF HARBORS ON LAKE ONTARIO EAST OF OAK ORCHARD, NEW YORK.

Officer in charge, Capt. Dan. C. Kingman, Corps of Engineers; Division Engineer, Col. Henry L. Abbot, Corps of Engineers.

1. *Charlotte Harbor, New York.*—The original project for the improvement of this harbor, adopted in 1829, proposed to connect the deep water in the Genesee River with the deep water in the lake by parallel piers or jetties about 480 feet apart. The present project, adopted in 1881, is to extend the jetties to the 15-foot curve in the lake, and to form a channel between them of navigable width and 15 feet in depth at low water by dredging. The natural channel was tortuous, and in calm weather would at ordinary stages of the lake, admit vessels drawing 8 feet.

The total amount expended from 1828 to June 30, 1892, is $457,919.82. The amount expended from the adoption of the present project in 1881 to June 30, 1892, is $139,841.50.

The total expenditures have resulted in extending the jetties to the 13-foot curve in the lake, and in securing by dredging a channel between them 2,700 feet long, 15 feet deep at extreme low water and 380 feet wide throughout, with the exception of the inner 1,100 feet, where it is 310 feet wide. It has also sufficed for the protection, preservation, and repair of existing works, and for the renewal of the perishable portions from the beginning of the work till the present time.

Though the deep water between the jetties is 15 feet, yet as they have only been extended to the 13-foot curve the full measure of the improvement is not available and can not be until the project is completed.

During the year 83,513 cubic yards of material has been dredged from the channel, and 235 linear feet of the superstructure of the west jetties has been rebuilt.

July 1, 1891, balance unexpended	$34,699.85
February 26, 1892, received from vessels for damages to piers	144.90
	34,844.75
June 30, 1892, amount expended during fiscal year	23,291.35
July 1, 1892, balance unexpended	11,553.40
Amount appropriated by act approved July 13, 1892	25,000.00
Amount available for fiscal year ending June 30, 1893	36,553.40
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	109,650.00

(See Appendix O O 1.)

2. *Pultneyville Harbor, New York.*—The project for the improvement of this harbor was adopted in 1870 (the date of the first appropriation), and proposed the construction of a timber breakwater running eastward from the west shore and then northward as a jetty, into the lake, also an east jetty parallel to and about 200 feet from the west one, and a dredged channel between them. The project was modified in 1875 to provide for increased dredging. The object of the improvement was to provide a channel of navigable width, and not less than 10 feet deep through the bar and into the mouth of Salmon Creek, which was the harbor. The natural channel was not more than 2 feet deep.

In 1884 it was proposed, in order to make the dredging of permanent value and effect, to build a sand-tight structure parallel to the breakwater and about 100 feet from it, between it and the beach, so as to arrest the movement of the beach sand and keep it out of the channel.

The total amount expended to June 30, 1892, is $72,630.77, and has resulted in the extension to the jetties to the 10-foot curve in the lake, and in the construction of about 200 feet of sand-tight bulkhead. A good deal of dredging has been done in the past, before the construction of the bulkhead, but the moving sand has reduced the available depth between the jetties to about seven feet; and along the breakwater and at the mouth of the creek the channel is only three or four feet deep. This renders it impossible for vessels to approach the wharves and warehouses which are within the mouth of the creek, and therefore the harbor is well-nigh useless. The few vessels that do come here are forced to lie at the outer end of the jetty channel in an exposed position, and transfer their cargoes to small boats.

The superstructure of the breakwater and of a greater part of the jetties is now very much decayed.

July 1, 1891, balance unexpended	$1,987.71
June 30, 1892, amount expended during fiscal year	1,618.48
July 1, 1892, balance unexpended	369.23
Amount appropriated by act approved July 13, 1892	1,000.00
Amount available for fiscal year ending June 30, 1893	1,369.23
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	9,000.00

(See Appendix O O 2.)

3. *Harbor at Great Sodus Bay, New York.*—The earliest projects for the improvement of this harbor, adopted in 1828, proposed the construction at the mouth of the bay of breakwaters from the east and

west shores, approaching to within 500 feet of each other, and connected at the opening with parallel jetties extending into the lake. The subsequent modifications were simply extensions of the original project to adjust it to the increased demands of commerce.

The present project was adopted in 1882, the object being to extend the jetties to the 15-foot curve in the lake, and to dredge a channel between them not less than 15 feet deep at extreme low water. The natural entrance into the bay was about 6 feet deep at low water. The natural channel at ordinary stages would admit vessels drawing 8 feet.

The total amount expended from 1829 to June 30, 1892, is $436,089. The amount expended from 1881 to June 30, 1892, is $64,317.26. The total expenditure has resulted in the construction of a timber breakwater 3,851 feet in length, and of two jetties 1,580 feet and 1,294 feet in length, the west one extending to the 15-foot curve in the lake and the east one to the 10-foot curve. It has also served for the protection, preservation, and repair of these works from 1829 to the present time, and for dredging from time to time, amounting in the aggregate to about 260,000 cubic yards, which has served to maintain a channel of navigable width between the jetties which has varied at different times from 8 to 15 feet in depth at low water.

The present available depth does not much exceed 9 feet at extreme low water.

July 1, 1891, balance unexpended	$13,763.80
June 30, 1892, amount expended during fiscal year	12,226.06
July 1, 1892, balance unexpended	1,537.74
July 1, 1892, outstanding liabilities	1,235.00
July 1, 1892, balance available	302.74
Amount appropriated by act approved July 13, 1892	15,000.00
Amount available for fiscal year ending June 30, 1893	15,302.74
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	43,000.00

(See Appendix O O 3.)

4. *Harbor at Little Sodus Bay, New York.*—The first project for the improvement of this harbor was adopted in 1829 and has since been variously modified.

The first appropriation was made in 1852. The first project proposed to partially close the opening between the bay and the lake by lateral dikes connected with two parallel jetties extending into the lake.

The present project, which is simply an expansion of the earlier ones, was adopted in 1881, and is designed to afford a channel of navigable width and not less than 15 feet deep at low water by extending the jetties and dredging between them. The original entrance into the bay had a depth of about 1¼ feet at extreme low water.

The total amount expended from the date of the first appropriation in 1852 to June 30, 1892, is $299,199.91.

The amount expended from the adoption of the present project in 1881 to June 30, 1892, is $64,758.14.

The total expenditure has resulted in the construction of 5,989 feet of dikes and jetties, which completes the dike work and extends the jetties to the 12-foot curve in the lake. It has also served for the protection, preservation, and repair of these works from the time they were built to the present time.

The available depth of water in the jettied channel is about 12 feet at low water. Effort was made during the past season to increase this depth by dredging. The material to be removed consisted mainly of hardpan, which proved to be very difficult to excavate. It was not found economical to attempt to remove it with a dredge alone. It will have to be first broken up with explosives. This work will be continued this season.

July 1, 1891, balance unexpended	$17,960.52
June 30, 1892, amount expended during fiscal year	16,218.66
July 1, 1892, balance unexpended	1,741.86
Amount appropriated by act approved July 13, 1892	6,000.00
Amount available for fiscal year ending June 30, 1893	7,741.86
Amount (estimated) required for completion of existing project	52,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix O O 4.)

5. *Oswego Harbor, New York.*—The earliest project for the improvement of this harbor was adopted in 1827, and proposed to inclose an area at the mouth of the Oswego River by extending jetties from the shore into the lake, joining the outer ends by a breakwater, and leaving an opening through which to enter the harbor. This project was completed in 1869, and forms the present inner harbor.

The present project was adopted in 1870, and consists of a breakwater 5,800 feet in length, generally parallel to the old west breakwater, and 1,100 feet in advance of it. The estimated cost was $1,161,682. This estimate of course did not include its subsequent repair and maintenance. This project was afterwards modified by the proposed construction of an east breakwater 2,700 feet in length, the reduction to 350 feet of the opening between the east end of the west breakwater and the north end of the light-house pier, the construction of spurs along the face of the outer west breakwater to reduce the effect of accumulated seas, and to provide for deepening by dredging the inner harbor at the mouth of the Oswego River.

The act of Congress of August 11, 1888, provided for the removal of the outer east breakwater, of which 250 feet had been built. This has been done, and the construction of an east breakwater now forms no part of the project.

In 1890 the project was further modified by providing for the protection and permanent maintenance of an opening that had been formed by waves in a storm through the outer breakwater near the western angle; the object of this opening being to keep the water in the harbor pure by allowing a circulation through, and to provide another entrance for small vessels. The natural entrance to the mouth of the the river was shallow and difficult of access, and afforded very little shelter to vessels of any considerable size.

The object of all these improvements has been to give protection and shelter to the city docks and wharves and to the commerce of the harbor, and to make a depth suitable for the deepest draft vessels on the lake.

The total amount expended from the adoption of the project to June 30, 1892, is $1,759,842.31.

The amount expended from the adoption of the present project in 1870 is $1,286,461.44. The total expenditure has resulted in the completion of the original project of 1827, and in the construction of the outer west breakwater; the reduction to 350 feet of the opening between the east end of this breakwater and the north end of the light-house pier, the construction and removal of about 250 feet of the east breakwater, the completion of two spur cribs, and the deepening of the river mouth to a depth of 15 feet at low water; in the securing full protection to the docks and wharves west of the river mouth, and channels of entrance 16 feet deep and 350 feet wide to the inner and outer harbors, and in securing increased depth in the inner harbor.

In addition, the various works have been cared for and maintained, and the perishable portions renewed when necessary, from the beginning of the work in 1829 to the present time.

The operations of the fiscal year have been the renewal of the superstructure on 170 feet of the outer breakwater; the removal by dredging of about 17,000 cubic yards of gravel and stone from the river mouth in the inner harbor, increasing the available depth about 2 feet; the removal by dredging of 10,000 cubic yards of sand from the outer harbor along the breakwater, increasing the available depth from about 10 or 12 feet to 17 feet, and general repair work to the permanent structures as it was required.

July 1, 1891, balance unexpended	$29, 170. 51
June 30, 1892, amount expended during fiscal year	23, 381. 95
July 1, 1892, balance unexpended	5. 788. 56
July 1, 1892, outstanding liabilities	10. 00
July 1, 1892, balance available	5, 778. 56
Amount appropriated by act approved July 13, 1892	40, 000. 00
Amount available for fiscal year ending June 30, 1893	45, 778. 56
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	85, 000. 00

(See Appendix O O 5.)

6. *Harbor at Sacketts Harbor, New York.*—The project for the improvement of this harbor was adopted in 1881, and proposed the deepening of the harbor by dredging over an area of about 15 acres to a depth of 12 feet at low water. The depth previously existing was less than 8 feet over a large part of this area. In 1826 and 1828 the sum of $6,000 was expended in clearing and deepening this harbor.

The total amount expended from 1826 to June 30, 1892, is $14,368.01. The amount expended from the adoption of the present project to June 30, 1892, is $8,368.01, and has resulted in the removal of 24,010 cubic yards of sand, mud, and gravel from the harbor, and in the construction of a stake and fascine dike 164 feet in length, with a mooring crib 18 feet square at its extremity to shelter the basin and exclude gravel drift from it. With the completion of this work the harbor had a depth of 12 feet at low water over about 6 acres of its area, except in a small place where the presence of rock in place limited the depth to a little less than 12 feet.

July 1, 1891, balance unexpended	$503. 95
June 30, 1892, amount expended during fiscal year	54. 69
July 1, 1892, balance unexpended	449. 26
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	5, 000. 00

(See Appendix O O 6.)

IMPROVEMENT OF SHOALS IN ST. LAWRENCE RIVER, AND OGDENSBURG HARBOR, NEW YORK, AND OF RIVERS AND HARBORS ON LAKE CHAMPLAIN, NEW YORK AND VERMONT.

Officer in charge, Maj. M. B. Adams, Corps of Engineers; Division Engineer, Col. Henry L. Abbot, Corps of Engineers.

1. Shoals between Sister Islands and Crossover Light, St. Lawrence River, New York.—The act of August 11, 1888, provided for a survey of the shoals between Sister Islands and Crossover Light, in the St. Lawrence River, New York, which, being made, was submitted July 2, 1889, and printed in Report of the Chief of Engineers, 1889, pages 2463 and 2464. The entire improvement was estimated to cost $43,305.

The act of September 19, 1890, appropriated $5,000 for this improvement, which has been pledged under contract for the removal of the upper and lower shoals.

Work can be carried on most advantageously in the winter season when thick ice has formed, but as the ice did not form of sufficient thickness in the winter of 1890–'91 to bear the machinery, etc., necessary in connection with such operations, the time for the completion of the contract was extended so as to include another winter, and again the ice did not become thick enough, but operations are expected to be commenced during the month of July and to be completed on time as extended, August 31, 1892.

July 1, 1891, balance unexpended	$4,909.44
July 1, 1892, balance unexpended	4,909.44
July 1, 1892, amount covered by uncompleted contracts	3,952.00
July 1, 1892, balance available	957.44
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	10,957.44
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	28,305.00

(See Appendix P P 1.)

2. Ogdensburg Harbor, New York.—The present project for the improvement of this harbor was adopted in 1890, and contemplates the deepening of the various channels leading from the deep water of the St. Lawrence River and that along the city front so as to afford a depth of 17 feet at extreme low water, at an estimated cost of $158,950.

When operations were commenced at this harbor the channels afforded depths from 5 to 12 feet only, and now there are three good channels from deep water in the St. Lawrence River to the nearest docks or wharves, in which water 15 to 16 feet deep is afforded, and a channel 12 to 15 feet deep has been made along the city front. The appropriation of September 19, 1890, has been pledged under contract and will be consumed in deepening the channels at this harbor.

The total amount expended from the date of the first appropriation in 1852 to June 30, 1892, has been $174,449.33, and from the adoption of the project of 1882 to that of 1890 some $40,000 was expended.

July 1, 1891, balance unexpended		$41,130.80
June 30, 1892, amount expended during fiscal year		13,574.57
July 1, 1892, balance unexpended		27,556.23
July 1, 1892, outstanding liabilities	$2,569.68	
July 1, 1892, amount covered by uncompleted contracts	21,777.03	
		24,346.71
July 1, 1892, balance available		3,209.52
Amount appropriated by act approved July 13, 1892		40,000.00
Amount available for fiscal year ending June 30, 1893		43,209.52
Amount (estimated) required for completion of existing project		76,850.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix P P 2.)

3. *Breakwater at Rouse Point, Lake Champlain, New York.*—The project for this improvement was adopted in 1885, and contemplates the construction of a breakwater composed of rubble and large stone on a straight line from Stony Point until the 18-foot curve in the lake is reached, a total distance of about 2,000 feet.

The estimated cost of the breakwater is $110,000. Work was commenced by contract September, 1885, and has been in progress since then. Four contracts have been worked out and resulted in the construction of some 1,700 linear feet of completed breakwater.

The good effects of the breakwater are apparent in the increased shelter afforded at the docks and wharves.

July 1, 1891, balance unexpended	$7,962.53
June 30, 1892, amount expended during fiscal year	7,954.56
July 1, 1892, balance unexpended	7.97
Amount appropriated by act approved July 13, 1892	15,000.00
Amount available for fiscal year ending June 30, 1893	15,007.97

(See Appendix P P 3.)

4. *Great Chazy River, New York.*—The act of August 11, 1888, provided for a survey of Great Chazy River, New York, from its mouth on Lake Champlain to Champlain village, which being made, was submitted July 3, 1889, and printed in the Report of the Chief of Engineers, 1889, page 2466.

The first estimate for the improvement of this stream provided for a least width of 50 feet, and a least depth of 6 feet, at a cost of $34,000, afterwards reduced to a channel 40 feet wide and 5 feet deep at a cost of $18,000.

The act of September 19, 1890, appropriated $10,000 for this improvement, which was placed under contract and expended in widening and deepening the channel in accordance with the project.

July 1, 1891, balance unexpended	$9,955.59
June 30, 1892, amount expended during fiscal year	9,955.59
Amount appropriated by act approved July 13, 1892	5,000.00
Amount (estimated) required for completion of existing project	3,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix P P 4.)

5. *Breakwater at Gordon Landing, Lake Champlain, Vermont.*—The project for this improvement was adopted in 1887, and has for its object the construction of a stone breakwater, composed of rubble and large

stones, extending in a straight line to the 16-foot curve in the lake, for the purpose of affording increased shelter to a landing on the west shore of Grand Isle, Lake Champlain, Vermont.

Construction commenced August 11, 1887, and was completed September 19, 1891. The structure terminated at 675 feet in length instead of 800 feet as originally contemplated.

July 1, 1891, balance unexpended	$5,956.05
June 30, 1892, amount expended during fiscal year	5,956.05

(See Appendix P P 5.)

6. *Plattsburg Harbor, New York.*—The first appropriation for the improvement of this harbor was in 1836.

The project then adopted and the modifications that have been made since have resulted in the construction of 1,550 linear feet of breakwater, the protection of a portion of the beach, and the dredging of some shoal areas within the harbor.

Under the appropriation of September 19, 1890, amounting to $32,500, proposals were invited and a contract made for repairing the superstructure of the existing breakwater and for prolonging the breakwater 300 feet northward.

Operations are in progress, but the contract does not require completion until November, 1892.

The total amount expended at this harbor to June 30, 1892, has been $170,404.67, of which amount $82,224.66 was expended since the adoption of the modified project of 1870.

July 1, 1891, balance unexpended		$31,120.25
June 30, 1892, amount expended during fiscal year		15,844.91
July 1, 1892, balance unexpended		15,275.34
July 1, 1892, outstanding liabilities	$4,052.68	
July 1, 1892, amount covered by uncompleted contracts	8,991.32	
		13,044.00
July 1, 1892, balance available		2,231.34

(See Appendix P P 6.)

7. *Burlington Harbor, Vermont.*—This improvement dates from 1836; modifications of the original plan have been made from time to time so as to afford adequate protection to the increasing commercial and shipping interests of the harbor. The last modification, made in 1886, provides for further extension of the breakwater both to the north and to the south, with its gradual withdrawal as it is prolonged into water about 30 feet deep instead of 38 feet deep, so as to reduce the cost.

Operations during the past year consisted in the repair of 1,000 linear feet of the breakwater superstructure under contract for the material and by hired labor.

The balance of the appropriation of September 19, 1890, $15,759.89, will be expended in repairs as needed.

The total amount expended to date has been $566,162.31, and under the existing project, $59,580.19.

July 1, 1891, balance unexpended	$19,531.62
June 30, 1892, amount expended during fiscal year	3,771.73
July 1, 1892, balance unexpended	15,759.89
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	129,000.00

(See Appendix P P 7.)

8. *Otter Creek, Vermont.*—The project for this improvement proposes the formation of a channel of navigable width and a least depth of 8 feet from Vergennes, Vt., to Lake Champlain.

The appropriation of September 19, 1890, $5,000, was expended under contract in the removal by dredging of 20,995 cubic yards from such shoals as most required deepening.

There has been expended to June 30, 1892, $41,500.

The stream now requires some 2,000 yards of rock excavation to carry out the original scheme for improvement, but unfortunately the channel afforded is not likely to prove permanent.

July 1, 1891, balance unexpended	$4,979.17
June 30, 1892, amount expended during fiscal year	4,979.17
Amount appropriated by act approved July 13, 1892	10,000.00

(See Appendix P P 8.)

9. *Ticonderoga River, New York.*—The project for this improvement was adopted in 1881, its object being to afford a channel of navigable width and least depth of 8 feet at low water from Ticonderoga village to Lake Champlain, a distance of about 2 miles.

The original estimated cost of the improvement was $42,516, and the amount expended has resulted in an improved channel.

The appropriation of September 19, 1890, $2,000, was expended under contract, and operations consisted in the dredging and removal of 8,132 cubic yards of material from shoals near the mouth of the river.

July 1, 1891, balance unexpended	$1,977.75
June 30, 1892, amount expended during fiscal year	1,977.75
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	26,016.00

(See Appendix P P 9.)

10. *Narrows of Lake Champlain, New York and Vermont.*—The project for this improvement was adopted in 1885, and has for its object the removal of such obstructions in the channel as will afford a least depth of 12 feet, and a least width of 150 feet from Whitehall to the Elbow, and 12 feet depth and 200 feet width along Cedar Mountain and across Kenyon Bay.

The entire undertaking was estimated to cost $80,000; $45,000 had been appropriated, and the original project stood completed two years ago at a little more than half the estimated cost.

July 1, 1891, balance unexpended	$2,668.87
June 30, 1892, amount expended during fiscal year	378.83
July 1, 1892, balance unexpended	2,290.04
Amount appropriated by act approved July 13, 1892	18,500.00
Amount available for fiscal year ending June 30, 1893	20,790.04

(See Appendix P P 10.)

PACIFIC COAST.

IMPROVEMENT OF OAKLAND HARBOR, CALIFORNIA.

Officer in charge, Col. G. H. Mendell, Corps of Engineers, having under his immediate orders Lieut. H. C. Newcomer, Corps of Engineers, the entire year, Lieut. Charles L. Potter, Corps of Engineers, to July 28, 1891, and Lieut. Clement A. F. Flagler, Corps of Engineers, since June 7, 1892.

The principal features of this improvement as originally projected are (1) two mid-tide training walls of rubble stone extended from the shore westward into San Francisco Bay about 2 miles; (2) a connection by a canal 1½ miles in length with the estuary of San Leandro; (3) a dam at the mouth of this estuary; (4) dredging of basins and channels to give a depth of 20 feet at low tide, which at high tide will accommodate vessels of the largest class.

Two modifications of the original project have been adopted, namely, to increase the width of tidal canal from 300 to 400 feet, and to raise the height of jetties from half-tide level to full high water.

In the original condition of the entrance the low-water channel depth was about 2 feet, admitting at time of high tide vessels drawing 6 to 8 feet of water. The present navigable condition is a convenient channel from Bay of San Francisco to the main wharves of Oakland, for the most part 300 feet in width, and at no point less than 225 feet in width, with a low-water depth of 14 feet, admitting vessels of 18 feet draft at ordinary high water. In the upper basin the navigation is confined to vessels of about 10 feet draft or less.

The total amount expended on this improvement was on June 30, 1892, $1,452,180.70.

The operations of the past year are as follows:

The contracts in force at beginning of the year for dredging the basin, for stone work on the jetties, for piers and steel superstructure of a highway bridge over the canal at Park street, Alameda, were completed during the year.

The amount of dredging in basin was 632,905 cubic yards of spoil securely placed ashore behind levees.

The north jetty was completed excepting a little work required to finish the enlarged terminal mound. The amount of stone delivered on the jetty during the year is 9,815 tons, and it was laid up in form to the extent of 31,528 square feet of dry masonry.

Some work had been done in excavating for bridge piers at the beginning of the year. The excavation was finished, the concrete piers put in, and the steel superstructure was erected during the year. The bridge was completed on December 7, 1891, and has since been open to travel. The length of the bridge is 383 feet, including approaches, and the quantity of metal 195½ tons. The piers contain 2,351.8 cubic yards of masonry.

The contract for excavating the canal had at the beginning of the year been advanced to the extent of 250,820 cubic yards. Progress was made during the year to the extent as measured of 142,088 cubic yards, leaving for fulfillment of contract an estimated amount of 107,000 cubic yards, which is in default, the contract date of fulfillment having been June 30, 1892.

The contract for additional improvement of channel in front of wharves of Oakland requires work to begin on July 18, 1892.

The operations contemplated for the ensuing year are improvement of the channels, continued excavation of the canal, completing the existing portion of the south jetty, and extending it.

July 1, 1891, balance unexpended	$247,266.79
June 30, 1892, amount expended during fiscal year	164,847.49
July 1, 1892, balance unexpended	82,419.30
July 1, 1892, amount covered by uncompleted contracts	63,676.37
July 1, 1892, balance available	18,742.93
Amount appropriated by act approved July 13, 1892	150,000.00
Amount available for fiscal year ending June 30, 1893	168,742.93

Amount (estimated) required for completion of existing project	$841,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q Q.)

IMPROVEMENT OF NAPA RIVER, REDWOOD CREEK, AND SAN LUIS OBISPO, WILMINGTON, AND SAN DIEGO HARBORS, CALIFORNIA.

Officer in charge, Lieut. Col. W. H. H. Benyaurd, Corps of Engineers, having under his immediate orders Lieut. James J. Meyler, Corps of Engineers, the entire year, and Lieut. Charles L. Potter, Corps of Engineers, since July 29, 1891.

1. *Napa River, California.*—The project is to clear the river of snags and the banks of overhanging trees interfering with navigation, and to dredge the bars between Vernon Mills and Carr Bend, in the immediate vicinity of Napa City, so as to give throughout that stretch a navigable channel 75 feet wide and 4 feet deep at low water.

Work upon the improvement was commenced in 1889. During that year the river was cleared of snags, and a gravel bar near the steamboat landing was removed by dredging.

During the past year operations were continued under contract with Thomas H. Williams, jr. Thirty-two snags were removed, and a channel of the required width and depth was dredged through 16 bars, requiring the removal of 21,972 cubic yards of material.

The entire work contracted for was completed December 11 last, leaving the river in good boating condition, and completing the present project. The work can not be considered of a permanent character, as the bars will re-form from material brought down during winter storms. Appropriations will therefore be needed in the future to maintain the channel in a fair navigable condition.

The total amount appropriated for this work is $17,500, and the total amount expended to the close of the fiscal year is $17,458.57.

July 1, 1891, balance unexpended	$12,219.20
June 30, 1892, amount expended during fiscal year	12,177.77
July 1, 1892, balance unexpended	41.43

(See Appendix R R 1.)

2. *Redwood Creek, California.*—This improvement is a continuance of that heretofore carried on under appropriations made for improvement of Redwood Harbor. The project for the latter work contemplated dredging the creek from the old steamer landing to Redwood City, a distance of about 6,000 feet, so as to give through that stretch a channel 50 feet wide and 3 feet deep at mean low tide. This work was completed in 1889. Examination made the following year showed that the channel had partially filled up from natural causes. The appropriation of $8,000 made by the river and harbor act of September 19, 1890, was for the purpose of redredging the channel and widening the passage through the middle ground.

Work was commenced upon this project about the middle of March last with the Government dredger belonging to the improvement of the San Joaquin River. At the close of the fiscal year the channel had been redredged for a distance of 4,600 feet, requiring the removal of 40,845 cubic yards of material. It is expected to complete the entire work before the end of August. As this will complete the project no additional appropriations are asked.

The present improvement, like the former, can not be considered of a permanent character. There being no tidal basin, there will be a constant tendency to shoaling, due to natural causes. Appropriations will therefore be needed in the future to maintain the creek in a navigable condition.

The total amount appropriated for dredging at Redwood is $23,400, of which $8,000 was for Redwood Creek, and the total amount expended to the close of the fiscal year, including outstanding liabilities, is $20,950.92.

July 1, 1891, balance unexpended	$8,000.00
June 30, 1892, amount expended during fiscal year	5,291.82
July 1, 1892, balance unexpended	2,708.18
July 1, 1892, outstanding liabilities	259.10
July 1, 1892, balance available	2,449.08

(See Appendix R R 2.)

3. *San Luis Obispo Harbor, California.*—The project for this improvement is intended to secure a protected anchorage and landing at Port Harford by the construction of a breakwater on Whaler Reef, extending from Point San Luis to Whaler Island, and thence to a point where the outer reef rises above high water. The total length of the structure, when completed, including the island, will be about 2,300 feet.

That portion of the breakwater between Point San Luis and the island, about 300 feet in length, was completed two years ago, and a commencement was made upon the extension beyond the island. During the past year the latter work has been continued under contract with the San Francisco Bridge Company, and the outer breakwater has been advanced a distance of about 300 feet, and depressions in the reef beyond have been partially filled. The total amount of rock placed upon the reef the past season was 7,870.5 tons. Work under the present contract will be completed in August.

The total amount appropriated for this improvement is $65,000, and the total amount expended is $52,053.07.

July 1, 1891, balance unexpended		$39,082.56
June 30, 1892, amount expended during fiscal year		19,435.79
July 1, 1892, balance unexpended		19,646.77
July 1, 1892, outstanding liabilities	$6,699.84	
July 1, 1892, amount covered by uncompleted contracts	11,952.04	
		18,651.88
July 1, 1892, balance available		994.89
Amount appropriated by act approved July 13, 1892		30,000.00
Amount available for fiscal year ending June 30, 1893		30,994.89
Amount (estimated) required for completion of existing project		189,900.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix R R 3.)

4. ***Wilmington Harbor**, California.*—Previous to the commencement of this improvement in 1871, there was a depth of less than 2 feet at the entrance at low tide. By the operations of dredging and jetty extension this depth was increased to 10 feet in 1881. The present project which was adopted in that year, was intended to secure a depth of 16 feet at mean low tide.

That depth has been obtained through the entire channel inside. Over the bar the depth is fully 14 feet at above stage of water.

During the past year operations have consisted in making needed repairs to the east jetty; in removing, by dredging and blasting, shoal places in the channel near Deadmans Island, and in raising and extending the west jetty.

Contractors delivered 21,309 tons of stone, which was used in strengthening the east jetty and in extending the west jetty. The latter work was advanced a further distance of 800 feet.

During the coming season the work of jetty extension will be continued to the extent of the available funds.

The total amount appropriated for this work is $904,000, and the total amount expended to close of the fiscal year, including outstanding liabilities, is $894,450.64.

July 1, 1891, balance unexpended	$85,568.18
June 30, 1892, amount expended during fiscal year	75,893.60
July 1, 1892, balance unexpended	9,674.58
July 1, 1892, outstanding liabilities	125.22
July 1, 1892, balance available	9,549.36
Amount appropriated by act approved July 13, 1892	51,000.00
Amount available for fiscal year ending June 30, 1893	60,549.36

(See Appendix R R 4.)

5. *San Diego Harbor, California.*—Before the adoption of the present project, the work carried on at San Diego had for its object the preservation of the harbor, which was being injured by the deposition of material brought down the San Diego River in flood stages. The river was diverted from its course, and caused to empty into False Bay. This was accomplished by building a substantial levee across the old channel of the river near its entrance to the harbor, and excavating a new water way leading to False Bay. This work was completed in 1876.

The present project for the improvement of the harbor contemplates the preservation and repair of the levee; securing a depth of 26 feet at mean low tide over the bar at the entrance by the construction of a jetty on Zuninga shoal, and maintaining a channel of 24 feet depth of water over the middle ground.

At the commencement of the fiscal year, dredging was in progress at the head of the middle ground. The channel was excavated for a width of 250 feet to a depth of 22 feet at mean low tide. This channel partially filled up again. It is not intended to continue operations at this point until the jetty at the entrance has been extended seaward sufficiently to control the movement of sand on Zuninga shoal.

No work has been done towards the construction of the jetty. Proceedings were instituted last October in the United States circuit court for the southern district of California, to condemn a strip of 18.85 acres on Coronado North Island, needed for jetty purposes. The case came to trial in June, and an award of $13,942.46 was made by the jury for the land in question. Upon possession of the land being obtained by the United States, the work will be commenced.

The total amount appropriated for the improvement of San Diego Harbor since 1875 is $192,500.

The total amount expended is $91,740.19, of which $82,085.37 was upon the construction and repair of levee across San Diego River,

July 1, 1891, balance unexpended	$58,512.16
June 30, 1892, amount expended during fiscal year	7,752.35
July 1, 1892, balance unexpended	50,759.81
Amount appropriated by act approved July 13, 1892	50,000.00
Amount available for fiscal year ending June 30, 1893	100,759.81
Amount (estimated) required for completion of existing project	284,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix R R 5.)

EXAMINATION, BY BOARD OF ENGINEERS, FOR DEEP-WATER HARBOR ON THE PACIFIC COAST BETWEEN POINTS DUME AND CAPISTRANO, CALIFORNIA, MADE IN COMPLIANCE WITH PROVISIONS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

In compliance with the provisions of the act a Board of Engineers, consisting of Col. G. H. Mendell and Lieut. Cols. G. L. Gillespie and W. H. H. Benyaurd, Corps of Engineers, was constituted to examine the Pacific coast between Points Dume and Capistrano with a view to determining the best location for a deep-water harbor, and to report a project and estimate of cost for the same. The report of the Board was submitted under date of December 8, 1891, and was transmitted to Congress and printed as House Ex. Doc. No. 39, Fifty-second Congress, first session.

The Board, after full examination, concludes that the selection of a site for a deep-water harbor within the limits designated by the act is restricted to the harbors in Santa Monica Bay and San Pedro Bay, and is of the opinion that San Pedro is the better of these, and submits alternative estimates of the cost of the necessary breakwaters as follows:

If constructed of rubble and concrete	$4,594,494
If constructed entirely of rubble	4,137,591

After a careful consideration of the facts in the case as presented by the Board, its views as to the location and general estimates of construction are concurred in by me. The difference in cost of the two breakwaters, for the same arcs of protection, is over $700,000 in favor of San Pedro, and when the other advantages of San Pedro, as detailed by the Board, are taken into consideration, it would seem that its selection has been properly made.

(See Appendix R R 6.)

IMPROVEMENT OF SAN JOAQUIN, MOKELUMNE, SACRAMENTO, AND FEATHER RIVERS, PETALUMA CREEK, AND HUMBOLDT HARBOR AND BAY, CALIFORNIA.

Officer in charge, Maj. W. H. Heuer, Corps of Engineers; Division Engineer, Col. G. H. Mendell, Corps of Engineers.

1. *San Joaquin River, California.*—At the time of the adoption of the project for this work, 1877, the low-water channel of the river to Stockton was only 6 feet deep, and the upper river was navigable for only six or seven months in the year for boats drawing 2 feet of water or less.

The original project contemplated a channel of 9 feet depth to Stockton, secured by dredging the shoal places and making cut-offs to straighten the river between its mouth and that city, and removal of snags, scraping bars, and building small wing dams in the upper river to improve its depth and prolong the boating season. This is the project of to-day, with the addition of the closure of several crevasses and sloughs which take water from the river and impair the scouring effect of its flood stages.

At the close of the fiscal year ending June 30, 1891, there had been spent on this work $195,853.61, mostly in dredging in Stockton Slough and the river proper, the making of three cut-offs below Stockton, and doing a little work in the upper river as proposed. This work had made navigation to Stockton practicable during the entire year for boats drawing 9 feet of water, but has not lengthened the boating season above Stockton Slough for boats of 3 feet draft, for the reason that little or no work has been done above Stockton.

During the present fiscal year the work consisted of dredging in Stockton Slough and the river in its near vicinity, to maintain the channels already secured, in building a dam to partially close Lairds Slough, rebuilding the dam at Paradise Cut, and making a cut-off at Head Reach; this latter, on account of insufficient funds, was only made one-half the width and less depth than originally intended; it will be increased both as to width and depth when more money is available. The cost of the above was $62,031.60.

The results have been the maintaining of the 9-foot channel to Stockton, work on which is needed annually, as the channels are not self-maintaining. Lairds Slough, near the village of Grayson, is a crevasse through which about 75 per cent of the water in the river flowed, and consequently lessened to that extent the flow below, thereby decreasing the depth. It was closed by a dam 310 feet long, 16 feet (average) high, 10 feet wide at crest, and 60 feet wide at base. Its effect was to confine the water to the main stream and increase the depth to Grayson.

At Paradise Cut a crevasse has existed for many years, and, with similar results as at Lairds Slough, has decreased the depths below. During this year it was partially closed by a dam, measuring at its crest 220 feet long, built up to 8 feet above low water—built to replace one carried away during 1889. The result as to keeping the river within its banks has been all that was hoped for.

The cut-off at Head Reach, 9 feet deep by 150 feet wide at the surface, was made to remove a much complained of impediment, as the Stockton boats always encountered in this bend a head wind, and the cut also lessened the distance considerably. The funds available sufficed only to excavate the channel to half the desired width, but the effect of the new channel is a marked improvement in the time made by the boats engaged in navigation on the river. The cost of this cut-off was $27,239.41.

The following is a list, in the order of importance, of the works needed for improvement of this river, together with the estimated cost of the several items:

Dredging to maintain 9 feet depth to Stockton	$25,000
Raising dam at Paradise Cut	2,000
Making cut-off at Twenty-one Mile Slough	65,000
Making double cut-off below mouth of Stockton Slough	20,000
Increasing width and depth of cut at Head Reach	37,750
Survey of upper river to Firebaugh's Ferry	5,000
Snagging and building wing dams	10,000
Total	164,750

July 1, 1891, balance unexpended	$63,002.53
June 30, 1892, amount expended during fiscal year	62,033.08
July 1, 1892, balance unexpended	969.45
Amount appropriated by act approved July 13, 1892	65,000.00
Amount available for fiscal year ending June 30, 1893	65,969.45

(See Appendix S S 1.)

2. *Mokelumme River, California.*—Before improvement the navigation of the river was difficult and dangerous on account of numerous snags and overhanging trees, and in 1884 a project for its improvement was made, the object being the removal of the obstructing snags and trees. Both forks of the river were cleaned out in 1884, 1885, 1886, 1887, and 1888, rendering navigation to Benson Ferry, the head of navigation, easy and safe. This completed the project as adopted, the cost being $12,457.62. No work was done during the last fiscal year.

For further improvement of this river it will be necessary to again remove the snags and overhanging trees, to close a private ditch emptying into the river near New Hope, and to remove a shoal formed there; also, to remove a point of land near New Hope, to facilitate landing there, and straighten the entrance into the north fork from the main river. The estimated cost of these works is $9,100, which amount could be advantageously expended in one fiscal year.

The commerce on this river is carried by one steamer of 395 tons, making three round trips a week. Rates of transportation are $1 less per ton than by railway; the improvement has, therefore, been a benefit to shippers at least to that extent.

July 1, 1891, balance unexpended	$542.38
July 1, 1892, balance unexpended	542.38
Amount appropriated by act approved July 13, 1892	2,500.00
Amount available for fiscal year ending June 30, 1893	3,042.38
Amount (estimated) required for completion of existing project	6,600.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix S S 2.)

3. *Sacramento and Feather rivers, California.*—Before improvement navigation in these rivers was dangerous and difficult on account of numerous snags, shallow bars, and rapids. In 1874 a project was adopted having for its object the temporary improvement of the low-water channels by removal of snags, building of wing dams to concentrate the current, and the scraping of bars. Work under this project has been carried on every season, and, together with the closure of several breaks in the banks of both rivers which threatened to divert the streams from their channels, cost, up to June 30, 1891, $468,834.55. The results of the work were to secure and maintain on the Sacramento a good low-water channel from McIntosh Landing down to Butte City for boats drawing 2½ feet, from that point to Sacramento 4 feet of water, and below Sacramento a low-water channel with a least depth of 5 feet has been secured. On the Feather is Marysville, the head of navigation, and from that point down there is now a channel for barges drawing 2 feet of water. As work is required annually to maintain these conditions the operations during the fiscal year were directed to that end; from July 1 to September 11, 1891, the snag boat worked in the upper Sacramento River, where she removed 974 snags and built 5 wing dams, aggregating 536 feet in length. As the water was then at its

low stage it was impossible to take the snag boat into the Feather River; the channel there, however, has been maintained.

In June, 1892, the snag boat was again put in commission and at the end of the fiscal year was at work in the upper Sacramento. There was spent during the year $12,846.44.

These improvements have been of great benefit to a large and constantly increasing commerce, especially on the Sacramento River, which is the natural outlet for the products of the great Sacramento Valley. It has resulted in greatly reducing the freight charges and insurance rates.

The report of the Board of Engineers appointed to examine these rivers is printed in House Ex. Doc. No. 246, Fifty-first Congress, second session, and in Annual Report, Chief of Engineers, 1891, page 2990.

July 1, 1891, balance unexpended	$26,165.45
June 30, 1892, amount expended during fiscal year	12,846.44
July 1, 1892, balance unexpended	13,319.01
July 1, 1892, outstanding liabilities	350.00
July 1, 1892, balance available	12,969.01
Amount appropriated by act approved July 13, 1892	150,000.00
Amount available for fiscal year ending June 30, 1893	162,969.01

(See Appendix S S 3.)

4. *Petaluma Creek, California.*—Before improvement this channel was very crooked and in places bare at low water. The project adopted in 1880 contemplated securing a channel 50 feet wide and 3 feet deep at low water, by dredging. Up to June 30, 1891, $30,046.59 had been expended on dredging in 1880, 1881, 1882, 1883, and 1884, when a channel as projected was secured and several cut-offs made. This channel refilled and was again redredged in 1888. Having again refilled from drainage, in 1891 a contract was made for dredging, under which work was commenced in August and completed in December. The result was a completed channel 6,800 feet long, 40 to 50 feet wide; of this 4,200 feet was excavated to a depth of 3 feet below the lowest low water, while the balance, 2,600 feet, was dug to 28 to 30 inches below the same plane. The funds available were insufficient to complete the entire length to the greatest depth. In doing the work 37,025 cubic yards of material was removed from the channel at a cost of $5,846.36.

This channel extends from the railroad bridge to the town of Petaluma, and since its completion there has been no detention of boats on account of lack of water.

Experience has shown that this channel is not self-maintaining and will require occasional redredging.

July 1, 1891, balance unexpended	$5,953.41
June 30, 1892, amount expended during fiscal year	5,846.36
July 1, 1892, balance unexpended	107.05
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	10,107.05

(See Appendix S S 4.)

5. *Humboldt Harbor and Bay, California.*—Prior to commencement of work the channels in Humboldt Bay were shallow and vessels had much difficulty in getting to the wharves in Eureka, Arcata, and Hookton. There was also a bar in front of the entrance over which the channel

constantly shifted in position and varied as to depth, making the approach to the harbor both difficult and dangerous.

To remedy these conditions a project was adopted in 1881, to secure by dredging, a channel 13 feet deep and 200 feet wide to the head of Eureka wharves, and one of 10 feet deep and 100 feet wide to Arcata and Hookton. In 1882 a project was approved for a submerged jetty starting from the south spit and extending seaward 6,000 feet, for the purpose of concentrating the tidal flow and thereby keeping the bar channel in position. This project was modified in 1891 to the construction of two jetties starting from the north and south spits, extending out to the 18-foot curve and raised to high-water level at an estimated cost of $1,957,615, in addition to $100,000 for beach revetment.

There was expended up to June 30, 1891, on dredging, $96,061.55, and on training wall, mostly on the south spit, $141,913. The dredging was finished in 1884, when the channels above mentioned were obtained and that part of the project completed. These channels have since slightly refilled, but not enough to form a serious impediment to navigation. Work on the south jetty was commenced in 1889 under a contract entered into the previous year, and was continued under a second contract made with Simpson and Brown in February, 1891. Up to June 30, 1891, the south jetty had been built out to about 3,000 feet from shore and partly raised to high-water level. On the north spit preparations were completed for the construction of a jetty and shore-protection work, which it was found necessary to commence without delay owing to the erosion taking place and consequent widening of the entrance from 4,200 to 5,600 feet, entailing loss of velocity in the tidal flow and the formation of a shoal just within the entrance.

From July 1, 1891, work was continued on both the north and south spits until October 31, 1891, when the existing contract was completed. On the north spit 300 linear feet of shore protection was built near the root of the jetty, and the jetty itself built out 1480.5 feet in a southerly direction. At the south spit the jetty was extended some 600 feet, making in all 3,699.2 feet. Of this 3,200 feet was raised to high-water level, the remainder, on the outer end, sloping from that level to 7 feet below low water. The cost of the work on both spits for the year was $163,823.95.

As the south jetty has only been extended to about one-half the length designed and the north only just commenced, it is hardly to be expected that very material benefits to the channel over the bar would be produced, yet, as an indication in that direction, it has been noted that a reasonably fixed channel, varying from 18 to 20 feet deep, has been maintained during the past year, a condition hitherto unknown.

The total amount expended during the fiscal year ending June 30, 1892, was $156,412.68.

July 1, 1891, balance unexpended	$184,525.45
June 30, 1892, amount expended during fiscal year	156,412.68
July 1, 1892, balance unexpended	28,112.77
Amount appropriated by act approved July 13, 1892	150,000.00
Amount available for fiscal year ending June 30, 1893	178,112.77
Amount (estimated) required for completion of existing project	1,565,115.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	522,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix S S 5.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN OREGON AND WASHINGTON.

Officer in charge, Capt. Thomas W. Symons, Corps of Engineers, having under his immediate orders Lieut. Graham D. Fitch, Corps of Engineers, the entire year, and Lieut. Francis R. Shunk, Corps of Engineers, since March 29, 1892; Division Engineer, Col. G. H. Mendell, Corps of Engineers.

1. *Coquille River, Oregon.*—At the time that the work of improvement was begun the entrance to the Coquille River was considered very dangerous. It was by a long, tortuous, and narrow channel, skirting the south headland, studded with rocks from beyond the bar to a distance of one-half mile inside. The depth at low water was only about three feet, and the channel was constantly shifting. The channel sometimes, at long intervals, would break through the north spit and run directly out to sea just south of Rackliffe Rock, but never remained long in this position. At such times the entrance was comparatively safe and the channel was at its best. The mean rise of the tide was 4.1 feet.

The first plan of improvement was to construct two parallel high-tide stone jetties, 800 feet apart, running out to sea a sufficient distance to open and maintain a channel over the bar with a least depth of 8 feet at low water; the north jetty starting from Rackliffe Rock and the south jetty from a point on the left bank inside the entrance.

The cost of this improvement was estimated in 1878 at $164,200.

The law of August 11, 1888, authorized in addition, $5,000 to be expended in snagging between Coquille City and Myrtle Point, and for this same purpose the law of September 19, 1890, authorized an amount not to exceed $3,000.

Under date of May 8, 1891, the plan of improvement was modified to provide for an entrance width of 600 feet instead of 800 feet.

The estimated cost of completing the work in accordance with the modified project is $180,000.

Up to June 30, 1891, $77,012.61 had been expended on the works at the river mouth, and $6,883.90 for snagging; a total of $83,896.51.

The following results were obtained: For considerable periods the entrance would be straight, and 8 to 10 feet deep at low water; at other times winds and currents would heap the sand into the channel, causing it to shoal and spread out, or break away to the northward and form a new entrance, shallow and ill directed.

It was thought that these evils would be largely prevented by completing the north jetty; and it was decided to use the present appropriation for that purpose. The river had been thoroughly cleared of snags, with very great benefit to navigation.

The amount expended during the fiscal year ending June 30, 1892, was $18,403.47.

The north jetty was extended 137 feet, making a total length of 510 feet.

The results obtained are not very different from those of last year. The work upon the north jetty has helped to concentrate the currents upon the bar, and at times the channel has been 8 to 10 feet deep at low water. Ocean swells, however, soon occur, spread out the sands, and reduce the depth to 4 to 7 feet.

The appropriations, made in seven acts, amount to $130,000.

July 1, 1891, balance unexpended	$21,103.49
June 30, 1892, amount expended during fiscal year	18,403.47
July 1, 1892, balance unexpended	2,700.02
July 1, 1892, outstanding liabilities	110.00
July 1, 1892, balance available	2,590.02
Amount appropriated by act approved July 13, 1892	25,000.00
Amount available for fiscal year ending June 30, 1893	27,590.02
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	155,000.00

(See Appendix T T 1.)

2. *Entrance and harbor at Coos Bay, Oregon.*—The obstructions which existed at the entrance to this harbor before the works of improvement were begun consisted, first, of the outer bar which is of sand and is shifting in character; and secondly, of the inner shoals formed by the sands which accumulate in the spring, summer, and autumn, while the northwest winds prevail.

Under the action of these winds the spit on the north side advanced towards the south, contracting the navigable passage under Coos Head to a very small width, and usually making the outer channel follow the west side of the spit in a long and tortuous course across the bar.

The channel had at times broken through the north spit on a line whose general direction is from Fossil Point to a point just north of Coos Head. It was then direct, the depth greatest, and vessels could pass without trouble.

The mean rise of the tide was 5.6 feet.

The project for the improvement adopted in 1879 was to construct such a jetty of wood and stone as might be found best, from a point 250 yards below the northern extremity of Fossil Point, on a line towards the east end of Coos Head, this line curving so as to be directed at its outer end a little north of the Head. The estimated cost of this jetty was $600,000.

Its object was to prevent accretion on the south end of the north spit, and to open and maintain a deeper and more direct channel across the bar. The present project is to build two high-tide jetties of stone, one from Coos Head and one from the south end of the north spit, extending out towards the bar, and leaving an entrance width of about 1,500 feet. The project further contemplates the protection and holding of the sands on the north spit by plantations, to prevent their blowing over into the harbor.

The estimated cost of these works is $2,466,412.20.

The total amount expended up to June 30, 1891, was $269,840.48; $210,317.74 on the old project, and $59,502.74 on the new.

The Fossil Point Jetty had been built to a total length of 1,761 feet, but a considerable portion of this was simply a layer of heavy stone to prevent scour.

The results thus far had been to keep the channel over the bar from changing its position as much as formerly, and to commence the erosion of the north spit. This gave a better direction to the ebb and flood currents, and the troublesome cross currents inside the bay had practically disappeared. Storms repeatedly choked the bar channel with sand, and a swash channel broke through the spit, reducing the good effects of erosion. The existing works had not increased the bar depths.

The bar channel sometimes had a good depth of 12 to 15 feet at low water, sometimes shoaled to the same depth at high water.

The amount expended during the fiscal year ending June 30, 1892, was $62,161.43.

The new north jetty has been built to a total length of 4,800 feet, including the approach. Of this length 1,808 is beyond low-water mark.

There has been a marked improvement in the entrance to the bay. A survey made in March, 1892, shows the bar 2,000 feet inside its position in August, 1891, and a channel over the bar 18 feet deep at low water. This channel has been maintained for about 8 months in its present position, which is a little north of its position of last summer.

The total appropriation, made in eight acts, is $548,750.

July 1, 1891, balance unexpended		$68,909.52
Amounts expended by Treasury Department	$285.26	
June 30, 1892, amount expended during fiscal year	61,876.17	
		62,161.43
July 1, 1892, balance unexpended		6,748.09
July 1, 1892, outstanding liabilities		950.00
July 1, 1892, balance available		5,798.09
Amount appropriated by act approved July 13, 1892		210,000.00
Amount available for fiscal year ending June 30, 1893		215,798.09
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		2,131,412.20

(See Appendix T T 2.)

3. *Umpqua River, Oregon.*—Just below Scottsburg, the head of navigation on the Umpqua River, the channel was obstructed by five sandstone bars or ledges, 12 feet to 15 feet wide, and 1 foot to 2 feet below low tide at a low-river stage. They were separated by pools about 150 feet wide and 5 to 10 inches deep.

The Secretary of War having authorized the expenditure of the balance of the appropriation of March 3, 1871, viz, $4,685.89, in improving the river below Scottsburg, a project was submitted and approved in 1885 for making a channel 50 feet wide and 3 feet deep by drilling and blasting the rock and removing the broken pieces.

In September, 1889, a survey of the river was made and a new project submitted, which was approved October, 1890. This project provides for the removal of bowlders and ledges in the wharf basin at Scottsburg and below the basin, with a view of opening a channel way 50 feet wide and 4 feet deep at low water at an estimated cost of $9,000.

The amount expended up to June 30, 1891, was $6,992.42.

The result obtained was a navigable channel 50 feet wide and 2 feet deep at low water, extending nearly through the reefs below Scottsburg, where formerly there was only a depth of 1 foot or less.

The amount expended during the fiscal year ending June 30, 1892, was $7,252.74.

The project was nearly completed. Before its entire completion, however, the river rose and became muddy. There are in consequence some points of rock which will have to be removed before the project can be considered as fully completed.

The present appropriation is deemed sufficient for the completion of the existing project.

The appropriations, made in three acts, amount to $33,500.

July 1, 1891, balance unexpended	$8,693.47
Amount refunded February 9, 1892	2.55
	8,696.02
June 30, 1892, amount expended during fiscal year	7,252.74
July 1, 1892, balance unexpended	1,443.28

(See Appendix T T 3.)

4. *Mouth of Siuslaw River, Oregon.*—The Siuslaw River enters the ocean in the midst of a vast shifting sandy beach, without any headland or fixed point to determine or aid in determining the location of the entrance channel. The unconfined channel has a range of about one mile over which it wanders. The depth on the bar varies from 5 to 12 feet at low water, and the bar channel is very variable in position and direction.

The plan of improvement is to confine the outgoing and incoming waters between high-tide brush and stone jetties, so located as to direct the currents upon the bar in a direction practically perpendicular to the coast. The north jetty will be 4,500 feet long; the south jetty 3,200 feet, and they are to converge to an entrance 600 feet wide at the crest of the bar.

The amount expended to June 30, 1891, was $601.96.

The amount expended during the fiscal year ending June 30, 1892, was $29,816.90.

The work has been entirely of a preliminary character.

The appropriation, act of September 19, 1890, is $50,000.

July 1, 1891, balance unexpended	$49,398.04
June 30, 1892, amount expended during fiscal year	29,816.90
July 1, 1892, balance unexpended	19,581.14
July 1, 1892, outstanding liabilities	2,300.00
July 1, 1892, balance available	17,281.14
Amount appropriated by act approved July 13, 1892	20,000.00
Amount available for fiscal year ending June 30, 1893	37,281.14
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	630,000.00

(See Appendix T T 4.)

5. *Harbor at Yaquina Bay, Oregon.*—The usual low-water depths over the bar at Yaquina Bay before improvement were from 7 to 8 feet. Three distinct channels existed, constantly changing in position and depth. The south channel was the one mostly used, though rendered dangerous by rocks. The middle channel being usually the shoalest, was little used, though free from rocks; while the north channel, long, tortuous, and studded with rocks, was considered unnavigable.

The mean rise of tide was 7.1 feet.

The project adopted in 1881 was to construct a dike or jetty on the south side, to cause the south channel to shoal up, with a view to obtaining in the middle channel a least high-water depth of 17 feet. As originally projected, the dike was to start from near low-water line, and, rising 2 feet above mean low water, was to run out to sea a distance of 2,500 feet.

The stone for the jetty was to be deposited from barges, and cribs were to be used, if practicable. Both were found impossible, owing to roughness of the water, and accordingly the jetty had to be built from the shore end, by means of a tramway begun at high tide instead of low-tide level, making the projected length 3,700 feet.

In 1884 the jetty was extended shoreward a distance of 316 feet to close a gap washed out by the sea; this increased the total projected length to about 4,000 feet.

The present project, adopted in 1888, is to raise the south jetty to full high water without extending it further seaward, making its total length 3,748 feet, and to build a mid-tide jetty about 2,300 feet long on the north side of the entrance, extending from the north head along and behind the reef to a point opposite the end of the south jetty and about 1,000 feet from it.

The amount expended to June 30, 1891, was $451,239.57.

The south jetty had been built to full high water and to its full length of 3,748 feet. About 1,400 feet of the north jetty had been built at least as high as mean low water.

As a result the bar depth had increased to about 11 feet at mean low water, and the tendency of the channel to run straight out to sea had been materially increased.

The amount expended during the fiscal year ending June 30, 1892, was $84,108.69.

The north jetty has been extended to a total length of about 2,100 feet, of which 405 feet is in an incomplete condition. A large portion of the south jetty has been raised to full high-tide level.

The results have been highly satisfactory. The channel has been continuously straight, and recent soundings indicate a least depth over the bar of 16 to 18 feet.

The appropriations, made in eight acts, amount to $635,000.

July 1, 1891, balance unexpended		$98,760.43
Amount refunded March 17, 1892		.25
		98,760.68
Amount expended by Treasury Department	$195.37	
June 30, 1892, amount expended during fiscal year	83,913.32	
		84,108.69
July 1, 1892, balance unexpended		14,651.99
July 1, 1892, outstanding liabilities		4,100.00
July 1, 1892, balance available		10,551.99
Amount appropriated by act approved July 13, 1892		85,000.00
Amount available for fiscal year ending June 30, 1893		95,551.99
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		80,000.00

(See Appendix T T 5.)

6. *Tillamook Bay and Bar, Oregon.*—The channel over the bar is direct and shifts but little, so that the bar is considered one of the safest on the Oregon coast. A fair depth of water is maintained throughout the year, so that vessels drawing 13 feet can usually enter.

The bay at low tide consists of three channels of fair depth near the entrance, but shoaling to 1 or 2 feet near the head of the bay. Tillamook City, the principal town of the region, is situated on a tidal slough above the head of the bay, and can be reached only by light-draft vessels at high tide.

No general project for the improvement of the bay and bar has been approved. A special project was approved for the expenditure of the money appropriated by the act of August 11, 1888. This provided for a survey of the bar and entrance, and the construction of longitudinal and spur dikes, and shore protection works to deepen the water over Dry Stocking Bar, at the mouth of Hoquarton Slough, and to remove snags and overhanging trees from Hoquarton Slough.

The amount expended to June 30, 1891, was $4,922.95.

Hoquarton Slough had been cleared of snags as far as Tillamook City.

The amount expended during the fiscal year ending June 30, 1892, was $709.90.

No work was done beyond making a survey.

The appropriations, in three acts, amount to $20,700.

July 1, 1891, balance unexpended	$777.06
June 30, 1892, amount expended during fiscal year	709.90
July 1, 1892, balance unexpended	67.16
Amount appropriated by act approved July 13, 1892	15,000.00
Amount available for fiscal year ending June 30, 1893	15,067.16
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	85,000.00

(See Appendix T T 6.)

7. *Entrance to Nehalem Bay, Oregon.*—Nehalem Bay at high water is about 2 miles long by 1⅓ miles wide at the widest part, and is connected with the ocean by a narrow channel extending in a southerly direction about 3 miles. This channel varies in width from 1,000 to 2,000 feet at high tide; it is separated from the ocean by a low sandy peninsula, about 2½ miles long and ¼ mile wide. The entrance channel south of this peninsula is shifting, its northern and southern limits being about 1 mile apart. The channel across the bar at the entrance is ordinarily 5 to 6 feet deep.

The plan of improvement is to hold the channel in its southern position by building two high-tide stone jetties; the northern starting from the above-mentioned peninsula, and the southern to start from the mainland; these to converge to an entrance width of about 500 feet, and then, if necessary, to run parallel for a sufficient distance to secure a bar depth of 8 feet at low water.

The cost, as estimated in 1891, will be $712,338.

There was no expenditure up to June 30, 1891.

The amount expended during the fiscal year ending June 30, 1892, was $415.08.

No work was done beyond making a survey.

The appropriation, in one act, amounts to $10,000.

July 1, 1891, balance unexpended	$10,000.00
July 30, 1892, amount expended during fiscal year	415.08
July 1, 1892, balance unexpended	9,584.92

(See Appendix T T 7.)

8. *Upper Columbia and Snake rivers, Oregon and Washington.*—Under the above head it has been deemed proper to officially include the continuous Columbia and Snake rivers from Celilo, at the head of the Dalles, to Lewiston.

The Upper Columbia and Snake form a continuous line of navigable river, but broken by many rapids which render navigation difficult and dangerous. These rapids are in nearly every instance caused by rocky bars with occasional bowlders. The channels before improvement were crooked and narrow, the ruling depth at low water over many of the bars was 2 to 3 feet, and some were practically impassable at low water.

Previous to 1877, $20,000 had been appropriated for the work of improvement, and had been expended in surveys and rock removal at the principal rapids.

In 1877 a project was approved which provided for the removal of bowlders and reefs, and for scraping gravel bars in the Columbia and Snake as far as Lewiston.

The estimated cost was $132,000.

The amount expended up to June 30, 1891, was $134,442.23.

The general result of all work done and of natural forces had been to lower the bed of the river about 1½ feet, but the surface was lowered also, so that the navigable depth was not increased. The removal of bowlders and reefs had been very beneficial by making navigation less dangerous.

No work had been done since 1889, and a number of large bowlders had been brought into the river by ice and freshets.

The amount expended during the fiscal year ending June 30, 1892, was $8,275.04.

Two hundred and ninety-three cubic yards of reef and bowlder rock was removed. The benefit to navigation was very great. Boats can carry more than double their previous loads, and with greater safety.

The present project or plan of improvement consists in removal of bowlders, gravel bars, and rock ledges, and putting in such contraction works as may be necessary.

The estimated cost of the work has not been accurately determined because of the lack of continuous and full surveys, and because from the nature of things it can not be, as many of the obstructions which it is necessary to remove are continually recurring.

The appropriations, made in fourteen acts, amount to $271,000.

July 1, 1891, balance unexpended	$16,557.77
June 30, 1892, amount expended during fiscal year	8,275.04
July 1, 1892, balance unexpended	8,282.73
July 1, 1892, outstanding liabilities	25.00
July 1, 1892, balance available	8,257.73
Amount appropriated by act approved July 13, 1892	15,000.00
Amount available for fiscal year ending June 30, 1893	23,257.73

(See Appendix T T 8.)

9. *Columbia River between head of Rock Island Rapids and foot of Priest Rapids, Washington.*—The portion of the Columbia River from the head of Rock Island Rapids to the foot of Priest Rapids is about 60 miles in length. The banks for the greater part of the distance are precipitous bluffs from 1,000 to 3,000 feet high. The neighboring country is rocky and sterile. The principal obstructions to navigation are Rock Island, Cabinet, and Priest rapids.

At Rock Island Rapids the river has cut around both sides of a large island of rock. The channel is obstructed by reefs, rocks, and sharply projecting points. These dam up the water to such an extent that it escapes over lines of very steep slope. Above the head of the island the channel is nearly choked by extensive deposits of gravel. The river has a fall of 10 feet in 3,000 feet, and 12½ feet in 8,000 feet at a stage of about 4 feet above low water.

At Cabinet Rapids a mass of basaltic rock projects from the left bank nearly two-thirds across the river, deflecting the current and causing it to impinge upon the nearly vertical rocks of the right bank. The channel is also obstructed by masses of rock.

The fall here is 10 feet in about 8,000 feet.

At Priest Rapids there are seven principal rapids in about 10 miles. The total fall in this distance is 72 feet at low water; 63½ feet at high water.

In all these rapids the river runs through and over hard, rough, and jagged basaltic rocks.

The plan of improvement under which existing work has been carried on consists in removing rocks at the three rapids, and putting in at convenient locations iron posts and ringbolts, to which ascending boats could make fast their lines and wind themselves up with steam capstans.

The estimated cost was $550,000.

In addition to this, the survey was to be continued from Rock Island Rapids to the boundary line.

This project was approved October 18, 1890.

The amount expended up to June 30, 1891, was $31,291.13, of which $2,691.91 was for the survey.

The work so far done was at Priest and Cabinet rapids. The results were not marked. The removal of the rocks would have rendered navigation safer, had there been any navigation, which there was not.

The survey had progressed rapidly so that the work from the boundary line to the mouth of the Spokane was nearly finished.

The amount expended during the fiscal year ending June 30, 1892, was $28,195.29, of which $7,227.95 was for the survey, and $20,967.34 for the work of improvement.

The work of improvement was confined to Cabinet and Rock Island Rapids.

At Cabinet Rapids a number of rocks and points have been shattered by blasting. Should the high water, as is expected, carry away the débris, these rapids will be improved to as great an extent in the way of rock removal as seems necessary.

At Rock Island Rapids obstructions in the channel near the right bank have been removed.

At both localities a number of ringbolts have been put in at various points.

The total appropriation by act of September 19, 1890, is $70,000, of which $10,000, or as much thereof as may be necessary, may be used for the survey of the Columbia River from the international boundary line to Rock Island Rapids.

July 1, 1891, balance unexpended	$38,708.87
June 30, 1892, amount expended during fiscal year	28,195.29
July 1, 1892, balance unexpended	10,513.58
July 1, 1892, outstanding liabilities	25.00
July 1, 1892, balance available	10,488.58

(See Appendix T T 9.)

10. Chehalis River, Washington.—The possibly navigable portion of the Chehalis River from Claquato to the mouth is about 90 miles long. This may well be considered in three sections.

First. From the mouth to Montesano, a distance of 13 miles, there is a depth of 18 feet at high water. This portion of the river can be traversed by coasting vessels.

Second. From Montesano to Elma, 16 miles, there is in general sufficient water for light-draft boats, but navigation is obstructed by logs and fallen trees, and in summer by scarcity of water on the bars. This portion of the river is slightly affected by the tides.

Third. Above Elma the river is practically blockaded during the summer and autumn by snags and general lack of water; it becomes a succession of pools and shoals, the latter having sometimes only 6 inches to 12 inches of water.

The plan of improvement contemplates the removal of snags, overhanging trees, jams, drift heaps, shoals, and other obstacles to navigation.

The amount expended to June 30, 1891, was $10,614.60. The river between Montesano and Gray Harbor was put into good condition for navigation.

The amount expended during the fiscal year ending June 30, 1892, was $100.68.

The river from Montesano to the bay has been kept open and free from dangerous snags.

The appropriations, made in five acts, amount to $13,000.

July 1, 1891, balance unexpended	$2,385.40
June 30, 1892, amount expended during fiscal year	100.68
July 1, 1892, balance unexpended	2,284.72

(See Appendix T T 10.)

11. Skagit, Stillaguamish, Nooksack, Snohomish, and Snoqualmie rivers, Washington.—These rivers rise in the Cascade Range and flow to the west into Puget Sound between the forty-eighth and forty-ninth parallels of latitude. The Snoqualmie is a branch of the Snohomish. The aggregate length of all is estimated at about 250 miles.

In their original condition these rivers had enough water for steamer navigation, but were obstructed by snags, fallen trees, and log jams. They were the highways of the country, travel on land being almost impossible on account of the heavy timber, dense underbrush, and fallen logs.

The plan of improvement contemplates the removal of snags, logs, trees, and other obstructions to navigation. For this purpose a snag boat with full outfit has been provided, which passes from one river to another as necessity requires.

The amount expended to June 30, 1891, was $62,118.51. No permanent results were aimed at or obtained. Obstructions were removed as they occurred, and the rivers were kept open for navigation.

The amount expended during the fiscal year ending June 30, 1892, was $5,377.07.

As a result the rivers were kept clear and navigation was greatly benefited.

The appropriations, in seven acts, amount to $84,500.

July 1, 1891, balance unexpended	$7,381.49
June 30, 1892, amount expended during fiscal year	5,377.07
July 1, 1892, balance unexpended	2,004.42
July 1, 1892, outstanding liabilities	200.00
July 1, 1892, balance available	1,804.42
Amount appropriated by act approved July 13, 1892*	15,000.00
Amount available for fiscal year ending June 30, 1893	16,804.42

(See Appendix T T 11.)

---

*This appropriation was made under the title "improving Puget Sound and its tributary waters, Washington."

EXAMINATIONS AND SURVEYS, MADE IN COMPLIANCE WITH PROVISIONS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Olympia Harbor, Washington, from deep water in Budds Inlet to Fourth Street Bridge, in the city of Olympia, and separately from said bridge to the mouth of the Des Chutes River at Tumwater*, was made by the local engineer in charge, Capt. Symons, and report thereon submitted, through Col. G. H. Mendell, Corps of Engineers, Division Engineer, Pacific Division. It is the opinion of Capt. Symons and of the division engineer, based upon the facts and reasons given, that Olympia Harbor, from deep water in Budds Inlet to Fourth Street Bridge, is worthy, and from the bridge to mouth of Des Chutes River at Tumwater is not worthy of improvement. This opinion being concurred in by me, no further survey from Fourth Street Bridge to Tumwater was ordered, but Capt. Symons was charged with and has completed survey of Olympia Harbor from deep water in Budds Inlet to the bridge, and submitted report thereon.

The proposed improvement of Olympia Harbor below the Fourth Street Bridge contemplates dredging a channel from deep water in Budds Inlet to the wharves near the bridge, 12 feet deep at low water and 250 feet wide between pile and brush bulkheads built 400 feet apart, beyond which the dredged material is to be deposited, and the formation of a basin at the upper end of the cut near the bridge, 12 feet deep at low water, with an extreme length of 1,600 feet and maximum width of 500 feet, the bulkhead to be continued around the sides and end of the basin so as to deflect the current of the Des Chutes River, provision being made, however, to allow small boats to pass through the draw of the bridge. The cost of this work is estimated at $275,000.

The reports were transmitted to Congress and printed as House Ex. Doc. No. 32, Fifty-second Congress, first session. (See also Appendix T T 12.)

The required preliminary examinations of the following localities were made by the local engineer in charge, Capt. Symons, and reports thereon submitted through Col. G. H. Mendell, Corps of Engineers, Division Engineer, Pacific Division. It is the opinion of Capt. Symons, and of the division engineer, based upon the facts and reasons given, that these localities are worthy of improvement. The conclusions of these officers being concurred in by me, Capt. Symons was charged with and has completed their survey and submitted reports thereon. The reports were transmitted to Congress and printed as executive documents of the Fifty-second Congress, first session.

1. *Tillamook Bay and Bar, Oregon.*—The proposed improvement of Tillamook Bay contemplates forming a connection between the north and middle channels above Bay City by dredging a channel 200 feet wide at bottom and 6 feet deep at low water, and constructing a dike along the west side of this channel and extending across the middle channel so as to divert the current through the cut for the purpose of maintaining it; constructing a dike to close the south channel and to turn its current into the middle channel, for the improvement of Junction Bar; and closing, by a dike, one of the channels at the outlet of Hoquarton Slough, for the improvement of Dry Stocking Bar. The total cost of this work is estimated at $100,000. No improvement of the bar at the entrance of the bay is proposed at the present time. Printed as House Ex. Doc. No. 35. (See also Appendix T T 13.)

2. *Swinomish Slough, Washington, with the view of constructing a ship channel through the same, connecting Saratoga Passage and Skagit Bay with Padilla Bay.*—The improvement recommended for the accommoda-

tion of the class of smaller vessels navigating Puget Sound, contemplates dredging a channel 100 feet wide and 4 feet deep in Swinomish Slough and across the flats at its northern and southern entrances to a sufficient depth of water in Padilla Bay and Skagit Bay, forming a basin near Goat Island by widening the channel to 200 feet for a length of 750 feet, and construction of dikes where necessary for protection of the cut and retention of wasted material. The total cost of this work is estimated at $122,000. Printed as House Ex. Doc. No. 31. (See also Appendix T T 14.)

EXAMINATION, BY BOARD OF ENGINEERS, FOR SHIP CANAL TO CONNECT LAKES UNION, WASHINGTON, AND SAMAMISH WITH PUGET SOUND, WASHINGTON, MADE IN COMPLIANCE WITH PROVISIONS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

In compliance with the provisions of the act a Board of Engineers, consisting of Col. G. H. Mendell, Maj. Thomas H. Handbury, and Capt. Thomas W. Symons, Corps of Engineers, was constituted to select and survey location and estimate cost of proposed ship canal, in Seattle and its vicinity, to connect lakes Union, Washington, and Samamish with Puget Sound. The report of the Board was submitted under date of December 15, 1891, and was transmitted to Congress and printed as House Ex. Doc. No. 40, Fifty-second Congress, first session.

A canal connecting lakes Samamish and Washington with a lock near Lake Washington to overcome the difference, 10.5 feet, in the level of the two lakes, is estimated to cost $4,927,230.

The proposed route and project for a canal connecting Lake Washington with Puget Sound contemplates constructing a canal 2,600 feet long, 80 feet wide at bottom and 158 feet wide at the water line, and 26 feet deep through the portage between Union Bay, in Lake Washington, and Lake Union, with a masonry lock 400 feet long, 50 feet wide, 26 feet deep over sill, and with a lift of about 7.5 feet; dredging channels to connect this canal with deep water in Lake Washington, and across Lake Union; and constructing a canal 6,700 feet long, 80 feet wide at bottom and 158 feet wide at the water line, and 26 feet deep, connecting Lake Union along its outlet with the head of Salmon Bay. From the head of Salmon Bay to Puget Sound two routes are considered by the Board; one by way of Salmon Bay and Shilshole Bay, with a lock near the sound 400 feet long, 50 feet wide, and 16.6 feet deep over sill at low tide; the other by way of Smiths Cove and a canal 80 feet wide at bottom, 158 feet wide at the water line, and 26 feet deep, to be constructed across the neck of land between the head of Salmon Bay and Smiths Cove with a lock near the sound similar to that projected for Shilshole Bay. The construction of a basin and formation of a channel through the shoals at the outlet of the lock are also contemplated. The estimated cost of the proposed canal between Lake Washington and Puget Sound by the two routes, not including damages for lands submerged, is as follows:

Smiths Cove route	$3,500,000
Shilshole Bay route	2,900,000

Concerning the comparative advantages of the two routes the Board states:

> The Shilshole Bay system costs $600,000 less than that by Smiths Cove. On the other hand, the latter route possesses advantages in that its entrance is in the harbor of Seattle, whereas the entrance to the other is 5¼ miles distant; and secondly, the Smiths Cove entrance and lock are less exposed to bombardment by an enemy's fleet. For these reasons the Smiths Cove route is to be preferred.

(See Appendix T T 15.)

IMPROVEMENT OF WILLAMETTE RIVER, OREGON, AND OF LOWER COLUMBIA RIVER AND ITS TRIBUTARIES, OREGON AND WASHINGTON.

Officer in charge, Maj. Thomas H. Handbury, Corps of Engineers, having under his immediate orders Lieut. Edward Burr, Corps of Engineers, to November 14, 1891, and Lieut. Harry Taylor, Corps of Engineers, since November 12, 1891; Division Engineer, Col. G. H. Mendell, Corps of Engineers.

1. *Mouth of the Columbia River, Oregon and Washington.*—The project under which this work is being carried on was adopted in 1884. It contemplates providing a channel across the Columbia River Bar, having a depth of 30 feet at mean low tide. This is to be effected by concentrating the water flowing over the bar and increasing the resultant currents to such a degree as to procure the desired depth. Any work for accomplishing this end must be more or less tentative in its character. The work which is now in progress is the building of a low-tide jetty, starting from Fort Stevens, on the South Cape, and extending in a westerly direction, with a slight curve to the south, out across Clatsop Spit, for a distance of 4½ miles, more or less, as circumstances may require, to a point about 3 miles south of Cape Disappointment. The jetty is constructed of stone, resting upon a mattress foundation about 40 feet wide and from 2½ to 5 feet thick. The stone extends to the level of 4 feet above mean lower low water. The material thus far has been placed in position from a jetty tramway supported upon piles driven along the line of the jetty and 24 feet above the level of low tide. The tramway is a double-track 3-foot-gauge railroad, the tracks being 13 feet between centers. The material is landed at the wharf and transported to place over these tracks, which are built in advance of the main work.

Before the commencement of this work the channel or channels over this bar were very capricious in location and variable in depth. The depths were usually from 19 to 21 feet, and the channels varied in number from one to three, and in location through nearly 180° from Cape Disappointment to Point Adams.

The results of the jetty already constructed are very marked in the building up of Clatsop Spit and in the effects produced by the concentration of water upon the bar. There is now a straight channel, having a width of one-fourth mile, with a depth nowhere less than 29 feet, and for a width of 1 mile a depth of 27 feet. At the end of the last fiscal year the shortest distance from the 30-foot curve on the outside to the same on the inside of the bar was 3,000 feet. This distance is now reduced to 1,200 feet. These depths refer to the plane of the mean of lower low waters.

The first appropriation for this improvement was made in the river and harbor act approved July 5, 1884. The total amount appropriated to the end of the present fiscal year for carrying out the project is $1,337,500. The amount expended, including outstanding liabilities, is $1,313,168.88, leaving a balance of $24,331.12, applicable to the further prosecution of the work.

At the end of last fiscal year the jetty tramway was at station 239 + 52, with the mattress work at station 235 + 40. Station 25 + 80 is regarded as the root or beginning of the jetty proper. During the month of July the tramway was extended 1,088 feet. Station 250 + 20 is regarded as the end of the jetty. This is 4¼ miles from the beginning, at station 25 + 80. From this station, east, to the end of the present wharf the distance is 3,080 feet, making the distance from the end of the wharf to the outer end of the jetty a little over 4.8 miles.

In view of the results obtained by the jetty at the end of the last fiscal year, as shown by the soundings taken at that time on the bar, it was deemed advisable to stop the construction of the jetty when it arrived at a point 4¼ miles from the inner end, and await further developments, which would be shown by the soundings to be taken during June of this year.

Under the contract dated January 22, 1891, in force with Joseph E. Smith, 150,500 tons of rock was received during the year. The total amount of rock received from all sources since the commencement of the work is 478,890 tons.

About 25,000 tons of this rock was used in securing the root of the jetty and in protecting the buildings and railway between that point and the wharf. The balance has been distributed along the line of the jetty. From the end of the jetty back for a distance of 2,500 feet the rock is raised to a level of 4 feet above datum; for 13,000 feet it is at a datum; for 5,200 feet it will average 4 feet above; for the remaining distance it will run from this level to high water. Near the inner end of the jetty it was found to be necessary to pile rock well up toward the high-water line to protect the piling of the tramway from the heavy drift brought down by the river during the winter and spring. At places along the line of the jetty it was observed that there was a decided tendency during the last of the flood tides and the first of the ebb for the water to flow across the jetty in great volume and with considerable velocity. Where this was the case the sand would not deposit in the vicinity, but would be scoured out, increasing the area of the water way. At these places rock was dumped in until this action ceased. It was found that when the jetty reached the height of about 4 feet above the mean level of low water, the flow during both ebb and flood was under control. The sand was deposited to the level of low water and above, in many instances, on both sides of the jetty.

On June 9, 10, and 11 surveys were made upon the bar at the mouth of the Columbia River with the view to developing the present condition of the channel in that locality. The conditions were favorable for this work, and the results make a very satisfactory showing. The 27-foot channel is now about 1 mile wide, and the 25-foot channel about 2 miles. The indications from this survey are all favorable to a permanent depth of channel of at least 30 feet. The shortest distance between the curves of this depth on the two sides of the bar is now but 1,200 feet.

The original estimate for the construction of this work was $3,710,000; of this amount there has already been appropriated to June 30, 1892, $1,337,500. There was a balance on hand at that date of $24,331.12, exclusive of outstanding liabilities.

July 1, 1891, balance unexpended	$274,710.46
June 30, 1892, amount expended during fiscal year	220,913.69
July 1, 1892, balance unexpended	53,796.77
July 1, 1892, amount covered by uncompleted contracts	29,465.65
July 1, 1892, balance available	24,331.12
Amount appropriated by act approved July 13, 1892	350,000.00
Amount available for fiscal year ending June 30, 1893	374,331.12

Amount (estimated) required for completion of existing project......	$175,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix U U 1.)

2. *Construction of canal at the Cascades, Columbia River, Oregon.*—The general scope of the improvement which it is desired to effect at the Cascades of the Columbia River includes a reach of about 4½ miles, where the river rushes through a narrow gorge in the Cascade Mountains. The fall in the distance is about 45 feet at high water and 36 feet at low water. The principal obstruction to navigation occurs at the upper end of the reach, known as Upper Cascades. The project for the improvement contemplates that the river should be improved below the Upper Cascades by removing bowlders and projecting points in the bed and banks so as to give good navigable water from its lowest up to a 20-foot stage. The fall at the Upper Cascades is to be overcome by digging a canal of 3,000 feet length across the neck of a low projecting spur, around which the river is forced at the entrance to the gorge, and placing in this a lock and other suitable structures, which would permit of the passage of boats up to a 20-foot stage of water in the river; this lock and canal to be so arranged that, should the future necessities of commerce so demand, additional structures may be added which will permit of navigation at much higher stages.

The first part of this project, that of improving the river below the foot of the Upper Cascades, is essentially finished.

The difference of level between the head and foot of the canal as now established is 15 feet at high water and 24 feet at low water, and difference in height between high and low water at the foot is 54 feet, and at the head 45 feet. The plan on which the future work in the canal, with its lock and accessories, is to be prosecuted, has for its object to make this portion of the river available for navigation to a stage up to 20 feet at the earliest possible moment, with the funds that are from time to time appropriated for the purpose.

At the commencement of the present fiscal year there was available for the prosecution of the work $204,691.71. At that time the principal work in progress was cutting stone, there being about fifty cutters employed. Other operations excepting current repairs were suspended on account of high water in the Columbia River. By the 1st of August the water had receded sufficiently to permit the lock pit to be pumped out. On the evening of the 7th, the water was practically all out of this. Preparations were at once made for resuming the work of placing concrete and setting stone in the north wall of the masonry of the lower lock and guard gate. Quarrying stone was resumed about the 20th of July. Concreting and stone-setting was resumed August 20. Work was pushed forward actively until December 5, when it became necessary to suspend the making of concrete and stone-setting. On the 11th of December stonecutting was discontinued. By the 19th the whole laboring force was discharged. The office force was moved to Portland on that date and employed during the winter in making up estimates of the season's work and in the preparation of detailed drawings for future work. The property at the works during this time was left in charge of watchmen. On April 4 the office force returned and the stonecutting and quarrying was resumed and continued to June 30. At that date the balance available for the prosecution of the work was $17,833.60.

The progress during the year towards completion is represented by the following general results. There were cut 2,074 cubic feet of dimension granite, 27,117 cubic feet dimension basalt, and 50,019 cubic feet basalt face stone. There were quarried 2,110 cubic yards of dimension stone and 604 yards of rubble from the bowlders found on the ground leased for this privilege.

Quantities of stone laid: In lock walls, 334 cubic yards of granite, 651 cubic yards basalt dimension stone, 2,003 cubic yards basalt face stone; in canal walls, 37 cubic yards basalt face stone, and 223 cubic yards dry rubble. Sixty-seven cubic yards of concrete culvert pipe 39 inches diameter, 6 inches through, was laid in the south lock wall.

The amount of concrete made and placed during the year was 17,899 cubic yards. There were used in this 15,720 barrels Portland cement, 8,475 cubic yards sand, 13,984 yards gravel, and 1,001 yards broken stone. Seventy-seven sections of concrete pipe 3 feet long, 39 inches diameter, and 6 inches thick, were made.

The masonry constructed during the year is the north abutment of the lower lock and guard gates, except the coping, and about 300 feet of the south wall of the lock chamber. The total amount of this masonry is 21,214 cubic yards.

The buildings and plant are now in a good state of repair and everything is in readiness to push the work forward as rapidly as the funds available and other circumstances will permit.

The portage railway constructed over the Government grounds at Cascade Locks was finished about the middle of September. This road connects with two steamboats, one running above the Cascades to the Dalles, the other running below to Portland. During the year there were about 18,150 passengers and 5,000 tons of freight transported by these two boats.

The amount expended upon this work to June 30, 1892, is $1,856,183.53. The available balance on hand at that time is $17,833.60. The estimated amount to be appropriated to complete the work is $1,419,250. The amount estimated that can be profitably expended during the fiscal year ending June 30, 1894, is $1,419,250.

July 1, 1891, balance unexpended		$208,483.71
June 30, 1892, amount expended during fiscal year:		
Portland office	$190,646.11	
Treasury Department	4.00	
		190,650.11
July 1, 1892, balance unexpended		17,833.60
Amount appropriated by act approved July 13, 1892		326,250.00
Amount available for fiscal year ending June 30, 1893		344,083.60
Amount (estimated) required for completion of existing project		1,419,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		1,419,250.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix U U 2.)

3. Columbia and Lower Willamette rivers below Portland, Oregon.—The object of this improvement is now to make and maintain a navigable channel from the city of Portland, Oregon, to the sea, having a low-water depth of 25 feet. There is included in this reach 12 miles of the Willamette River and 98 miles of the Columbia, measured along the deep-water channel. Before the commencement of the improvement in accordance with previous projects the low-water depth of channel at the shoalest places was between 10 and 15 feet. At the end of the present year there is a low-water depth of 20 feet throughout the entire distance, except at the points in Cathlamet Bay, where there is but 19 feet. The average rise of tide in this bay is 7 feet.

The original project under which this improvement has been carried on with modifications and extensions was adopted in 1877. Some dredging work had been done previous to that time. It contemplates that a navigable low-water channel having a depth of 20 feet should be maintained by means of permanent constructions to protect the banks, contract the rivers in wide places, direct the currents, and control the amount of water that should pass through sloughs having a detrimental influence upon the main channel. While these constructions were being put in place, and until their influence was fully developed, dredging was resorted to in several localities to give a temporary relief to commerce.

The amount expended by the United States in this improvement since the adoption of the project July 1, 1877, is $649,805.97. It appears that previous to that date $221,780.46 had been expended in various operations looking to the improvement of the Willamette and Columbia rivers between Portland and the sea. The aggregate of the appropriations and allotments including proceeds from sales of property to other appropriations up to June 30, 1892, is $889,745.71. In addition to this amount the citizens of the city of Portland have in various ways expended a considerable sum, the exact amount of which can not now be ascertained, in assisting to keep open a deep channel to the sea.

The amount available for this work at the end of the present fiscal year is $15,686.88.

The high water of last August in the Columbia washed away the earth around the east end of the dam at the head of Martin Slough. Before this could be repaired there was an opening eroded 142 feet wide and from 24 to 42 feet deep. This slough and the one just above, known as Burke Slough, were the original cause of the Martin Island Shoal. This opening was closed during September and October. The total cost of the work was $8,500.

The dam at Burke Slough was strengthened by the addition of 200 cords of fascines and 500 tons of rock. The cost of this repair was $1,290.

The chute on the south side of Swan Island, in the Willamette River, was closed by a dam 6,570 feet long, the top of which is 4 feet above low water. This dam is made of piles, brush, and rock, and cost $24,599.58. The work was done by contract.

Since the dam was completed it has been submerged by back water from the Columbia River. Its effect upon the bar at Swan Island would under this condition be nothing. The results will be developed after the next Willamette high water.

Dredging was done at Swan Island Bar during September and October to the extent of 21,860 cubic yards, at a cost of 12½ cents per yard, including all repairs and other expenses.

A project, with plans and estimates, for improving the Lower Willamette and Columbia rivers, so as to secure a navigable channel having at low water a depth of 25 feet from Portland to the sea, was called for by the river and harbor act approved September 19, 1890. The report upon this project, with drawings and estimates, has been submitted and is published as House Ex. Doc. No. 38, Fifty-second Congress, first session, and as Appendix U U 9 of this report. This project having received the approval of the Secretary of War, the Port of Portland, a corporation existing under the laws of the State of Oregon, applied for and was granted permission to assist in carrying it into execution, subject, however, to certain conditions looking to the protection of the interests of the United States in the matter, and with the distinct understanding that the United States shall not incur any liability on account of the work done by the Port of Portland, and that the War Department does not counsel, advise, or encourage the expenditure proposed by this corporation.

Under this permission the Port of Portland has practically finished the following work called for in the approved project: 4,000 feet of diking between the foot of Swan Island and St. Johns. At Post-Office Bar 6,300 feet of diking. The work at these two places was practically finished April 30. This is all the permanent work in the Willamette River called for by the project. Since their completion the dikes have been covered by back water from the Columbia. Under these conditions these dikes will have little or no effect upon the channel. When the Columbia River recedes and they can direct the currents of the Willamette favorable results may be expected.

In the Columbia River 11,750 feet of diking was built at Walker Island. This was completed May 28.

The 15,000 feet of diking at Snag Island, in Cathlamet Bay, called for by the project, is now under contract by the Port of Portland, and in process of construction.

In addition to the above work the Port of Portland has removed with the city dredge 32,725 cubic yards of material from the bar between the foot of Swan Island and St. Johns, leaving at that place a channel 100 feet wide, 21 feet deep, at low water; also 40,205 yards from Post-Office Bar, leaving a channel 150 feet wide, 21 feet deep; also 24,650 yards from the bar at Walker Island, leaving a channel 100 feet wide, 20 feet deep.

Of the work called for by the project, there are the additions to the present dike at St. Helens and the dike at Martin Island Bar that have not been commenced; also, practically, the whole of the dredging is yet to be provided for.

At the end of the fiscal year the effect of the work done under the project by the Port of Portland can not be ascertained. The Columbia River is at its high summer stage and over the top of all the dikes excepting those in process of erection in Cathlamet Bay.

July 1, 1891, balance unexpended	$61,912.22
June 30, 1892, amount expended during fiscal year	43,752.94
July 1, 1892, balance unexpended	18,159.28
July 1, 1892, amount covered by uncompleted contracts	2,472.40
July 1, 1892, balance available	15,686.88
Amount appropriated by act approved July 13, 1892	150,000.00
Amount available for fiscal year ending June 30, 1893	165,686.88
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	153,600.00

(See Appendix U U 3.)

4. *Willamette River above Portland, Oregon.*—The project for this improvement was adopted in 1878. It consists in snagging operations, bar scraping, contraction of water over shoals, and rock removal, with the object of giving easy navigation for light-draft boats from Portland to Eugene City, Oregon, a distance of 172 miles. The mouth of the Yamhill River, 40 miles above Portland, was the head of an inconvenient low-water navigation in a draft of 2½ feet; only 1 foot could be carried above.

During the low water of last season boats drawing 18 inches of water could ascend as far as Corvallis.

The total amount appropriated for this work to the end of the fiscal year since the present project was adopted is $124,000. At the commencement of the present fiscal year there was a balance on hand of $6,464.42.

The work done during the season consisted of snagging operations, covering the river from Portland to Ingrams Bend, 2 miles below Harrisburg, a distance of 150 miles, and in concentrating the water over shoal places by closing chutes and building wing dams. This work was done by the crew of the United States snag boat *Corvallis.*

During the season there were 577 snags removed and 940 feet of wing dams was built, which resulted in giving 2½ feet at low water as high up as Salem and extending the period for navigation above that point fully a month. This work, however, is but temporary, and in the nature of things much of it may have to be done over again.

The whole of the funds available for work under this appropriation was not expended at this time, when it might have been to good advantage to the upper portion of the river. A small portion was held in reserve to relieve any urgent necessity that might arise upon the river below Oregon City.

July 1, 1891, balance unexpended	6,464.42
June 30, 1892, amount expended during fiscal year	3,350.49
July 1, 1892, balance unexpended	3,113.93
Amount appropriated by act approved July 13, 1892	*30,000.00
Amount available for fiscal year ending June 30, 1893	33,113.93

(See Appendix U U 4.)

5. *Cowlitz River, Washington.*—The project for the improvement of this river, which was adopted in 1882, contemplates the removal of sand bars, rocks, snags, overhanging trees, and other obstructions in the channel from its mouth to a point about 50 miles above. Work has been done to Toledo, 30 miles above the mouth. The ruling depth at low water prior to this was 14 inches. It is now 30 inches, when the low water can be kept concentrated on one or two troublesome bars. The original estimate was $5,000 for the first year and an annual expenditure thereafter of $2,000 per year. The total amount that has been appropriated for this work is $19,000.

The snag boat *Corvallis* was sent into this river September 23, and worked there until the end of October. Her operations extended to Toledo. Fifty snags and sunken stumps were removed from the channel and a wing dam 400 feet long was built at Toutle River Bar. It extends from the right bank of the Cowlitz obliquely downstream, and concentrated the water so as to give a navigable channel at that place. The dam was built of short piles driven into the gravel, with logs and brush held down by gravel and rock. The work was done by the crew of the boat. The work was discontinued on account of a rise in the river. It could not be economically prosecuted at that time.

A crew was shipped for this boat and sent into the river again June 23. The work to be done at this time is the building of wing dams at Keegans Bar, about 3 miles below Toledo, for the purpose of increasing the depth of water at that point. At the end of the year, June 30, this work was in progress. This work will exhaust the balance of the appropriation of 1890 that is now available.

---

* Of which $3,000 is to be used in improving Yamhill River.

July 1, 1891, balance unexpended	$3,917.27
June 30, 1892, amount expended during fiscal year	1,901.96
July 1, 1892, balance unexpended	2,015.31
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	5,015.31

(See Appendix U U 5.)

6. *Youngs and Klaskuine rivers, Oregon.*—The project for this improvement contemplates the removal of snags, sunken logs, and overhanging trees from Youngs River as far up as the lower end of the cut-off, a distance of 7 miles, and also from the channel of the Klaskuine as far up as Kamm's Wharf, a distance of 2 miles. The latter river empties into the former 6 miles above Youngs Bay.

The estimated cost of this improvement was $1,600. The total amount appropriated for the work has been $1,600. The total amount expended is $1,206.79, which has resulted in a channel of 7 feet depth at high tide to the limits named. The balance now available, $393.21, will be sufficient to complete the project. No work was done during the year. No further appropriation is asked.

July 1, 1891, balance unexpended	$393.21
July 1, 1892, balance unexpended	393.21

(See Appendix U U 6.)

7. *Gauging waters of Columbia River, Oregon and Washington.*—The object of these gaugings is to ascertain and keep a record of the fluctuations of the Columbia River, with the view to gathering information that may be useful in works of improvement on the river, and also by gauges established at various points to indicate to pilots, captains, and others interested in navigation the stage of water on crossings and places of difficult navigation.

A self-registering tide gauge has been in operation at Astoria, Oregon, and one at Cathlamet, Wash., during the entire year.

Daily sheets from the Astoria gauge were exhibited on a bulletin board in that city. These show the stage of water and condition as to roughness on the bar at the mouth of the river, and are of great service to commerce.

July 1, 1891, balance unexpended	$962.32
June 30, 1892, amount expended during fiscal year	516.00
July 1, 1892, balance unexpended	446.32

(See Appendix U U 7.)

EXAMINATIONS AND SURVEYS, MADE IN COMPLIANCE WITH PROVISIONS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Maj. Handbury, and reports thereon submitted through Col. G. H. Mendell, Corps of Engineers, Division Engineer, Pacific Division. It is the opinion of Maj. Handbury and of the division engineer, based upon the facts and reasons given, that these localities are worthy of improvement. The conclusions of these officers being concurred in by me, Maj. Handbury was charged with and has completed their survey and submitted reports thereon. The reports were transmitted to Congress and printed as executive documents of the Fifty-second Congress, first session.

1. *Willamette River, Oregon, for improvement of navigation at Clackamas Rapids and Ross Island and near city of Corvallis.*—The proposed

improvement at Ross Island contemplates closing the middle and east chutes at that locality by dams to a height of 4 feet above low water, and to assist the erosion thus caused in the west chute or channel by such dredging as may be necessary to form a channel 100 feet wide and 14 feet deep at low water. It is also proposed to improve the bar about a mile above the head of Ross Island, in front of the town of Sellwood, by dredging a channel through it 100 feet wide and 14 feet deep, and by constructing a contracting dike about 400 feet long from one or the other bank. The estimated cost of the work proposed at these localities is as follows:

Ross Island:	
Construction of dams	$30,000
Dredging	13,000
Sellwood bar:	
Dredging	3,000
Construction of dike	4,800
Contingencies	5,100
Total	55,900

The proposed improvement at Clackamas Rapids contemplates removal of the old dam at the head of the rapids; construction of a dike to a height of at least 10 feet above low water, extending from a point just above the junction of the right bank of Willamette River with the left bank of Clackamas River 6,000 feet down the Willamette, so as to turn the current of the Clackamas more nearly parallel with that of the Willamette and impound the detritus brought down by the Clackamas on the shoals below its mouth and inclosed by the dike; and construction of a dike 6 feet high and 800 feet long to contract the channel at Jennings Shoal at the foot of the rapids. The total cost of this work is estimated at $78,000. Col. G. H. Mendell, Corps of Engineers, Division Engineer, Pacific Division, states that a preferable plan would be to store the débris in the Clackamas before it reaches the Willamette, and that before the work is begun an examination should be made to determine if this is practicable.

The proposed improvement at Corvallis contemplates clearing the chute in the first bend above Corvallis of obstructions, such as fallen trees and driftwood, and cutting away trees and underbrush along its banks, so as to provide a passage for the water during high stages, and thus improve the regimen of the river in this vicinity. The cost of this work is estimated at $5,000.

The total estimate of cost of the work proposed in the Willamette River at these localities is as follows:

Ross Island	$55,900
Clackamas Rapids	78,000
Corvallis	5,000
Total	138,900

Printed as House Ex. Doc. No. 28. (See also Appendix U U 8.)

2. *The Lower Willamette and Columbia rivers, Oregon, with a view of securing 25 feet at low water from Portland to the mouth of the Columbia.*—The project presented in Maj. Handbury's report of September 8, 1891, as amended by reports of the division engineer, dated October 5, 1891, and of The Board of Engineers, dated October 14, 1891, is submitted as the project for this work required by the act of September 19, 1890. The improvement proposed contemplates the formation, by dredging, dike construction, etc., of a channel 25 feet deep from Portland to the Pacific Ocean, at an estimated cost of $772,464.

Printed as House Ex. Doc. No. 38. (See also Appendix U U 9.)

3. Columbia River, from the mouth of Willamette River to the upper limits of the city of Vancouver, Washington, with a view of establishing a ship channel.—The improvement proposed contemplates diverting the current which passes behind Hayden Island into the main channel of Columbia River, so as to scour away the shoal now existing along the northern side of the island, which obstructs navigation by deep-sea going vessels.

The work recommended to be done to accomplish this object consists in closing the chute behind Hayden Island by a dam having a height of 4 feet above low water, a width of 6 feet at top and 25 to 30 feet at base in the deepest water, and a length of 3,000 feet, the banks at the two ends of the dam to be protected for a distance of 250 feet against erosion at high water. The cost of this work is estimated at $33,000.

Printed as House Ex. Doc. No. 36. (See also Appendix U U 10.)

SUPERVISION OF THE HARBOR OF NEW YORK.

Supervisor, Capt. Frederick Rodgers, United States Navy.

The office and functions of the supervisor of the harbor of New York were established by act of Congress approved June 29, 1888, entitled "An act to prevent obstructive and injurious deposits within the harbor and adjacent waters of New York City by dumping or otherwise, and to punish and prevent such offenses."

Under the provisions of section 5 of the act a line officer of the Navy is designated to discharge the duties created by the act, under the direction of the Secretary of War. On May 23, 1889, the Secretary of War directed that all communications in connection with these duties should be addressed to him through this office, and on February 1, 1890, he further directed that the powers conferred upon him by the act should be exercised through the Chief of Engineers.

The report of the supervisor of the harbor describing the operations in his charge for the fiscal year ending June 30, 1892, is submitted as Appendix V V.

The estimate of funds required for this service for the fiscal year ending June 30, 1894, is given in the above-mentioned report as follows:

ESTIMATE OF FUNDS REQUIRED FOR SUPERVISION OF THE HARBOR OF NEW YORK FOR THE FISCAL YEAR ENDING JUNE 30, 1894.

For pay of inspectors, deputy inspectors, office force, and expenses of office..	$20,000
For pay of crew and maintenance of steamer *Nimrod*	10,000
For pay of crew and maintenance of steamer *Argus*	10,000
For purchase or construction of two steam tugs	90,000
For pay of crew and maintenance of two steam tugs to be purchased or constructed	24,000
Total	154,000

The attention of this office has been called (see correspondence in the matter appended to the report of the supervisor) to what is believed to be a common practice by vessels entering New York Harbor of dumping ballast in the approaches to the harbor and bay off Sandy Hook, sometimes within and sometimes without the 3-mile limit to which the jurisdiction of the United States and of the supervisor of the harbor extends. In this way it appears that attempts are purposely made to avoid the jurisdiction of this Government. It is believed that in the course of time the continual deposit of large quantities of this material near the entrance of the harbor will be a source of danger and inconvenience to navigation, and measures should be taken to prevent such deleterious deposits within 15 miles of the Sandy Hook Light-ship, or in less than 16 fathoms of water. To prevent such dumping, especially beyond the 3-mile limit, the following act, which will, it is believed, accomplish the object desired in a legitimate manner, is proposed and recommended for passage by Congress:

AN ACT to prevent the dumping of ballast or other bulky material in the approaches to New York Harbor and Bay off Sandy Hook.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That any vessel or vessels from which may be dumped or discharged ballast or other bulky material in the approaches to New York Harbor and Bay within fifteen miles of the Sandy Hook Light-ship, or in less than sixteen fathoms of water, shall not be allowed by the collectors of customs to receive passengers or cargo or clear from New York or any port adjacent to New York Harbor and Bay for the period of six months from the time of the commission of such dumping or discharging of ballast or other bulky material.

SEC. 2. That it shall be the duty of the supervisor of the harbor of New York, appointed and acting under the provisions of an act entitled "An act to prevent obstructive and injurious deposits within the harbor and adjacent waters of New York City by dumping or otherwise, and to punish and prevent such offenses," approved June twenty-ninth, eighteen hundred and eighty-eight, to detect by proper measures any vessel or vessels which may dump or discharge ballast or other bulky material within the limits specified in the foregoing section of this act, and upon being satisfied of the commission of such act or acts to report the same to the collectors of customs at ports adjacent to New York Harbor and Bay for action by them in pursuance of the provisions in the said foregoing section; and the provisions of the said act approved June twenty-ninth, eighteen hundred and eighty-eight, and the jurisdiction of the said supervisor of the harbor of New York, are hereby extended, so far as they are applicable and consistent with the provisions of this act, to embrace the waters included within the limits specified in section one of this act.

SEC. 3. That the collectors of customs at any or all the ports adjacent to New York Harbor and Bay, upon receipt of information from the said supervisor of the harbor of New York that any vessel or vessels have dumped or discharged ballast or other bulky material within the limits specified in section one of this act, are hereby authorized and directed not to allow said vessel or vessels to receive passengers or cargo or clear from the respective ports within six months from the time of commission of such dumping or discharging of ballast or other bulky material, as provided in section one of this act.

MISSISSIPPI RIVER COMMISSION.

The Mississippi River Commission was organized under the provisions of the act of Congress of June 28, 1879.

Commissioners, Col. C. B. Comstock, Corps of Engineers, president; Lieut. Col. Chas. R. Suter, Corps of Engineers; Major O. H. Ernst, Corps of Engineers; Henry L. Whiting, Assistant U. S. Coast and Geodetic Survey; B. M. Harrod, Robert S. Taylor, and Henry Flad.

The report of the Commission for the fiscal year up to May 31, 1892, relating to surveys of the entire river, and works of construction and improvement, etc., in Mississippi River between the mouth of Ohio River and the head of the passes, is submitted as Appendix W W.

Estimates of funds for the fiscal year ending June 30, 1894.—The Mississippi River Commission submits the following estimate of the amount required for the fiscal year ending June 30, 1892, for carrying on continuously the work of improving Mississippi River in accordance with the provision in the river and harbor act approved July 13, 1892, which authorizes the Secretary of War to enter into additional contracts, or to purchase material and do the work otherwise than by contract, for the continuous prosecution of the improvement, to be paid for as appropriations may be made from time to time:

For improving Mississippi River between head of the passes and the mouth of Ohio River, including salaries, clerical, office, traveling, and miscellaneous expenses of the Mississippi River Commission	$2,665,000

The following statement of amounts that can be profitably expended in fiscal year ending June 30, 1894, for improvement at various localities on the Mississippi River, is submitted by the Commission in compliance with requirements of sections 2 of the river and harbor acts of 1866 and 1867:

At New Madrid, Mo	$45,000
At Memphis, Tenn	75,000
At Greenville, Miss	200,000
At Vicksburg, Miss	100,000
At Natchez, Miss., and Vidalia, La	400,000
At New Orleans, La	100,000
For rectification of Red and Atchafalaya rivers	300,000
Total	1,220,000

MISSOURI RIVER COMMISSION.

The Missouri River Commission was organized under the provisions of the act of July 5, 1884.

Commissioners, Lieut. Col. Chas. R. Suter, Corps of Engineers, president; Maj. A. Mackenzie, Corps of Engineers; Maj. O. H. Ernst, Corps of Engineers; Garland C. Broadhead, and Richard S. Berlin.

The report of the Commission for the fiscal year ending June 30, 1892, relating to surveys, works of construction and improvement, removal of obstructions, etc., in Missouri River below Sioux City, Iowa, is submitted as Appendix X X.

Estimate of amounts that can be profitably expended during fiscal year ending June 30, 1894.—The Missouri River Commission submits the following estimate of the amounts that can be profitably expended during the fiscal year ending June 30, 1894, upon the improvement of Missouri River below Sioux City, Iowa:

Office and traveling expenses and salaries of Commission	$20,000
Surveys and observations	25,000
Gauges, physical data, and publications	25,000
Operating snag boat	35,000
Systematic improvement in first reach	645,000
Total	750,000

HARBOR LINES.

The section in the river and harbor act of 1888 authorizing the establishment of harbor lines was amended and reënacted by the river and harbor act approved September 19, 1890, as follows:

> SEC. 12. That section 12 of the river and harbor act of August 11, 1888, be amended and reënacted so as to read as follows:
>
> Where it is made manifest to the Secretary of War that the establishment of harbor lines is essential to the preservation and protection of harbors, he may, and is hereby authorized to, cause such lines to be established, beyond which no piers, wharves, bulkheads, or other works shall be extended or deposits made, except under such regulations as may be prescribed from time to time by him; and any person who shall willfully violate the provisions of this section, or any rule or regulation made by the Secretary of War in pursuance of this section, shall be deemed guilty of a misdemeanor, and, on conviction thereof, shall be punished by a fine not exceeding $1,000, or imprisonment not exceeding one year, at the discretion of the court for each offense.

In cases where it had been made manifest to the Secretary of War that the establishment of certain harbor lines is essential to the preservation and protection of the harbors, the cases were referred to officers in local charge of the district in which the harbors are located or to boards of engineers specially appointed for the purpose, for consideration and report. The necessary examinations having been made, reports with maps were rendered, which were submitted to the Secretary of War by the Chief of Engineers, with recommendation that the lines as indicated be approved, and that the approval be placed upon the maps showing the harbor lines.

Under the requirements of law as cited, and in the manner described, harbor lines have been established as follows:

HARBOR LINES AT FIVE-MILE RIVER HARBOR, CONNECTICUT.

Col. D. C. Houston, Corps of Engineers, in compliance with instructions from this office, made report dated January 22, 1892; report submitted to the Secretary of War January 25, 1892; approved January 26, 1892. (See Appendix D 27.)

HARBOR LINES IN NEW YORK HARBOR AND ITS ADJACENT WATERS.

The Board of Engineers on harbor lines for New York Harbor and its adjacent waters, consisting of Cols. Henry L. Abbot, William P. Craighill, C. B. Comstock, and D. C. Houston, and Lieut. Col. G. L. Gillespie, Corps of Engineers, was constituted by Special Orders No. 11, Headquarters, Corps of Engineers, January 30, 1889.

a. (1) *Great Mill and Little Mill rocks, East River;* (2) *eastern shore of Gravesend Bay, from Fort Hamilton to Coney Island; and* (3) *southern shore of Raritan and Sandy Hook bays, from Cheesequake Creek to the highway bridge across Shrewsbury River at Navesink Highlands.*—Report dated February 8, 1892; submitted to the Secretary of War February 13, 1892; approved March 9, 1892.

b. *Modification of harbor lines in Jersey flats, in front of Bayonne, New Jersey, to permit solid filling and constructions by Mr. R. G. Packard outside the established harbor lines.*—An application by Mr. R. G. Packard for permission to build certain dikes, etc., and make solid filling outside the established harbor lines in Jersey Flats in front of Bayonne, N. J., was reported on by the Board October 13, 1891. The permission desired was granted by the Acting Secretary of War December 26, 1891, upon certain conditions and upon the filing by Mr. Packard of a bond to secure the construction and maintenance by him of a tidal prism behind the approved bulkhead line equal in volume to the displacement caused by the constructions exterior to the bulkhead line.

c. *Modification of harbor lines established January 9, 1891* (see Annual Report, Chief of Engineers, 1891, page 963), *on the north shore of East River, between Oak Point and Hunts Point.*—Report dated May 20, 1892; submitted to the Secretary of War June 7, 1892; approved June 11, 1892.

d. *Modification of pierhead line established March 4, 1890* (see Annual Report, Chief of Engineers, 1890, page 796), *on the Arthur Kill, in front of Perth Amboy, New Jersey.*—Report dated May 20, 1892; submitted to the Secretary of War July 15, 1892; approved August 9, 1892.

(See Appendix E 14.)

HARBOR LINES IN ANACOSTIA RIVER (EASTERN BRANCH OF THE POTOMAC) AT WASHINGTON, DISTRICT OF COLUMBIA.

The Board of Engineers on harbor lines for Anacostia River, consisting of Col. William P. Craighill, Lieut. Col. George H. Elliot, and Maj. Charles E. L. B. Davis, Corps of Engineers, constituted by Special Orders No. 10, Headquarters, Corps of Engineers, February 20, 1892, made report dated May 16, 1892; report submitted to the Secretary of War May 19, 1892; approved May 21, 1892. (See Appendix J 16.)

MODIFICATION OF HARBOR LINES IN SOUTH BRANCH OF ELIZABETH RIVER AT THE NAVY-YARD, NORFOLK, VIRGINIA.

The Navy Department, June 21, 1892, requested that the harbor lines established in south branch of Elizabeth River at the Norfolk navy-yard by the Secretary of War May 9, 1890 (see Annual Report, Chief of Engineers, 1890, page 1032), be modified so as to permit extension of the quay wall south of the entrance to the timber basin at the navy-yard. This modification was, upon the recommendation of the Chief of Engineers, approved by the Secretary of War June 30, 1892. (See Appendix K 9.)

HARBOR LINES AT SAN PEDRO, WILMINGTON HARBOR, CALIFORNIA.

The Board of Engineers on harbor lines for San Pedro, Wilmington Harbor, California, consisting of Col. G. H. Mendell, Lieut. Col. W. H. H. Benyaurd, and Maj. W. H. Heuer, Corps of Engineers, constituted by Special Orders No. 20, Headquarters, Corps of Engineers, March 25, 1891, made report dated July 8, 1892, recommending establishment of harbor lines additional to those established by the Secretary of War at this locality July 28, 1891 (see Annual Report, Chief of Engineers, 1891, page 2976); report submitted to the Secretary of War August 9, 1892; approved August 10, 1892. (See Appendix R R 7.)

HARBOR LINES IN SAN DIEGO HARBOR AND ADJACENT WATERS, CALIFORNIA—AT NATIONAL CITY, SAN DIEGO, ROSEVILLE, LA PLAYA, CORONADO, SPANISH BIGHT, AND CORONADO NORTH ISLAND.

The Board of Engineers on harbor lines for San Diego Harbor and adjacent waters, California, consisting of Col. G. H. Mendell, Lieut. Col. W. H. H. Benyaurd, and Maj. W. H. Heuer, Corps of Engineers, constituted by Special Orders No. 51, Headquarters, Corps of Engineers, October 11, 1888, made report dated June 13, 1892; report submitted to the Secretary of War June 21, 1892; approved June 21, 1892.

These lines include the harbor lines established at San Diego and Coronado by the Secretary of War, April 2, 1890 (see Annual Report, Chief of Engineers, 1890, page 2904).

(See Appendix R R 8.)

HARBOR LINES IN OLYMPIA HARBOR, VANCOUVER HARBOR (COLUMBIA RIVER AT VANCOUVER), AND BELLINGHAM BAY (AT NEW WHATCOM AND FAIRHAVEN), WASHINGTON.

The Board of Engineers on harbor lines for these localities, consisting of Col. G. H. Mendell, Maj. Thomas H. Handbury, and Capt. Thomas W. Symons, Corps of Engineers, constituted by Special Orders No. 16, Headquarters, Corps of Engineers, March 12, 1892, made report dated May 23, 1892; report submitted to the Secretary of War May 31, 1892; approved June 3, 1892. (See Appendix T T 16.)

HARBOR LINES IN WILLAMETTE RIVER AT PORTLAND, OREGON.

The Board of Engineers on harbor lines for Willamette River at Portland, Oregon, consisting of Col. G. H. Mendell, Maj. Thomas H. Handbury, and Capt. Thomas W. Symons, Corps of Engineers, constituted by Special Orders No. 88, Headquarters, Corps of Engineers, December 24, 1890, made a majority report, dated May 23, 1892; report submitted to the Secretary of War July 16, 1892; approved August 9, 1892. (See Appendix U U 11.)

BRIDGING NAVIGABLE WATERS OF THE UNITED STATES.

Plans and locations of the following bridges proposed to be erected across navigable waters of the United States have been examined with a view to protection of the interests of navigation, and have been approved by the Secretary of War under the requirements of the special acts of Congress authorizing their construction, or under the general provisions of the river and harbor acts approved September 19, 1890, and July 13, 1892; and copies of the plans and locations as approved have been sent to the officers of the Corps of Engineers in charge of the river and harbor districts in which the bridges are to be built, in order that they may supervise the construction so far as necessary to see that the bridges are built in accordance therewith:

1. *Bridge of the city of Snohomish, Washington, across Snohomish River.*—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Washington.

Plan and location submitted May 16, 1891; approved by the Secretary of War July 22, 1891; copy sent to Capt. Thomas W. Symons, Corps of Engineers, July 24, 1891.

Capt. Symons reported, December 5, 1891, the completion of this bridge.

2. *Bridge of the Valley Street Railway Company across Duwamish River, in Section 29, Township 24 north, Range 4 east, Washington.*—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Washington.

Plan and location submitted by the company September 2, 1891; approved by the Secretary of War October 17, 1891; copy sent to Capt. Thomas W. Symons, Corps of Engineers, October 20, 1891.

Capt. Symons reported, June 30, 1892, that this bridge was completed March 4, 1892, in accordance with the approved plans.

3. *Bridge of the Cherry Island Marsh Company across Brandywine Creek at Fourth street, extended, Wilmington, Delaware.*—Section 7 of river and harbor act approved September 19, 1890, and act of legislature of the State of Delaware.

Plan and location submitted by the company September 26, 1891; approved by the Secretary of War October 26, 1891; copy sent to William F. Smith, United States agent, Major of Engineers, U. S. Army, retired, October 30, 1891.

Maj. Smith reported, May 12, 1892, that the bridge had been completed in practical accordance with the approved plan.

4. *Bridge of Clatsop County, Oregon, across Walluski River.*—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Oregon.

Plan and location submitted by the county court February 13, 1891, and modified plan submitted September 16, 1891; approved by the Secretary of War October 26, 1891; copy sent to Maj. Thomas H. Handbury, Corps of Engineers, October 30, 1891.

5. *Bridges of the Snohomish, Skykomish and Spokane Railway and Transportation Company across Snohomish River in Section 32, Township 29 north, Range 5 east, Willamette meridian, Washington, and across Ebey Slough in Section 4, Township 28 north, Range 5 east, Willamette meridian, Washington.*—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Washington.

Plans and locations submitted July 7, 1891; approved by the Secretary of War October 30, 1891; copies sent to Capt. Thomas W. Symons, Corps of Engineers, November 4, 1891.

Capt. Symons reported, April 4, 1892, that these bridges had been completed; that across Ebey Slough in practical conformity with the approved plan, but that across Snohomish River not so, there being but one clear draw-opening of 99 feet in the stream instead of two of 100 feet each as called for by the approved plan; Capt. Symons states that this unauthorized departure from the approved plan will not work any detriment to navigation.

6. *Bridge of the Litchfield, Carrollton and Western Railroad Company across Illinois River between Columbiana and Kampsville, Illinois.*—Act of Congress approved March 3, 1883; amended by act approved October 1, 1890.

Plan and location submitted by the company October 22, 1890, and modified plan submitted November 28, 1890; approved by the Secretary of War November 4, 1891; copy sent to Capt. W. L. Marshall, Corps of Engineers, November 5, 1891.

7. *Bridge of the Nashville, Chattanooga and St. Louis Railway Company across Tennessee River at Johnsonville, Tennessee.*—This bridge being an obstruction to navigation, a notice dated July 12, 1889, from the Secretary of War was, under the provisions of river and harbor act of August 11, 1888, served upon the railway company requiring such alteration of the bridge as would render navigation through or under it free, easy, and unobstructed (see Annual Report, Chief of Engineers, 1890, page 340).

Proceedings being begun anew under the provisions of river and harbor act approved September 19, 1890, the company proposed to replace the old structure by a new bridge, which would be much more satisfactory than alteration of the existing structure. The plans for the new bridge submitted by the company were approved by the Secretary of War November 19, 1891, under section 4 of the act of September 19, 1890, the new bridge to be completed, and such portions of the old bridge as would obstruct navigation to be cleared from the river, on or before November 15, 1894. Copy was sent to Lieut. Col. Henry M. Robert, Corps of Engineers, November 21, 1891.

8. *Bridge of Lewis County, Washington, across Cowlitz River at Toledo, Lewis County, Washington.*—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Washington.

Plan and location received from the Board of County Commissioners July 10, 1891; approved by the Secretary of War November 19, 1891; copy sent to Maj. Thomas H. Handbury, Corps of Engineers, November 21, 1891.

9. *Bridge of the Navesink Railroad Company across Shrewsbury River at Highland Beach, New Jersey.*—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of New Jersey.

Plan and location submitted by the company October 12, 1891, and modified plan and location submitted November 19, 1891; approved by the Secretary of War December 2, 1891; copy sent to Capt. Thomas L. Casey, Corps of Engineers, December 4, 1891.

10. *Bridge of the Delaware Railroad Company across Christiana River on the line of its railroad in New Castle County, Delaware.*—River and harbor act approved September 19, 1890.

Plans for reconstruction of the old bridge at this locality were submitted by the company October 9, 1891; approved by the Secretary of War December 8, 1891; copy sent to William F. Smith, United States agent, Major of Engineers, U. S. Army, retired, December 11, 1891.

A slight modification of the approved plan, increasing the width of the draw span 5½ inches, and modifying the masonry construction, submitted by the company January 23, 1892, was approved by the Secretary of War January 28, 1892; copy sent to Maj. Smith January 29, 1892.

Maj. Smith reported, July 5, 1892, that the bridge had been completed in accordance with the modified plan as approved.

11. Bridge of Limestone County, Alabama, across Elk River at Elk River Mills, Alabama.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Alabama.

Plans submitted by the Commissioners November 9, 1891; approved by the Secretary of War December 9, 1891; copy sent to Capt. George W. Goethals, Corps of Engineers, December 12, 1891.

Capt. Goethals reported, January 27, 1892, that the bridge had been completed in accordance with the approved plan.

12. Bridge of Board of Park Commissioners of Boston, Massachusetts, across navigable water way between Q Street, Boston, and Castle Island, Massachusetts.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Massachusetts.

Plans and location submitted by the Commissioners September 16 and November 27, 1891; approved by the Secretary of War December 12, 1891; copy sent to Lieut. Col. S. M. Mansfield, Corps of Engineers, December 23, 1891.

13. Bridge of the Oregonian Railroad Company across Yamhill River near Lafayette, Yamhill County, Oregon.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Oregon.

Location and plan for reconstruction of bridge at this point were submitted by the company October 17, 1891; approved by the Secretary of War December 12, 1891; copy sent to Maj. Thomas H. Handbury, Corps of Engineers, December 17, 1891.

14. Bridge of the Ocean Springs Bridge Company across main channel of Fort Bayou at Ocean Springs, Jackson County, Mississippi.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Mississippi.

Plan submitted by the company September 12, 1891; approved by the Secretary of War December 14, 1891; copy sent to Maj. A. N. Damrell, Corps of Engineers, December 22, 1891.

15. Bridge of the Lake Shore and Michigan Southern Railway Company across Huron River at Huron, Ohio.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Ohio.

Plan and location submitted by the company September 8, 1891; approved by the Secretary of War December 18, 1891; copy sent to Lieut. Col. Jared A. Smith, Corps of Engineers, December 21, 1891.

16. Bridge of the Milwaukee, Lake Shore and Western Railway Company across Sheboygan River in Sheboygan, Wisconsin.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Wisconsin.

Plan for new bridge to replace the old one at this locality submitted by the company November 19, 1891; approved by the Secretary of War December 23, 1891; copy sent to Maj. Charles E. L. B. Davis, Corps of Engineers, December 29, 1891.

17. Bridge of the city of Albany, Oregon, across Willamette River.—Act of Congress approved December 26, 1890.

Plan and location submitted by the city May 16, 1891, and new plan and location submitted October 24, 1891; approved by the Secretary of War December 23, 1891; copy sent to Maj. Thomas H. Handbury, Corps of Engineers, December 29, 1891.

18. Bridge of the South Twenty-second Street Bridge Company across Monongahela River at Pittsburg, Pennsylvania.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Pennsylvania.

Plan and location submitted by the company August 15, 1891, and modified plan submitted December 16, 1891; approved by the Secretary of War December 26, 1891; copy sent to Maj. D. W. Lockwood, Corps of Engineers, December 31, 1891.

19. Bridge of the Superior Belt Line and Terminal Railway Company across St. Louis River, Wisconsin and Minnesota, about 12 miles above Superior, Wisconsin.—Act of Congress approved February 24, 1891.

The rights granted the Duluth, Red Wing and Southern Railroad Company by the act of February 24, 1891, were relinquished by it to the other beneficiary of the act, the Superior Belt Line and Terminal Railway Company. Plan and location were submitted February 14, 1891, and modified plan and location received September 16, 1891; approved by the Secretary of War December 26, 1891; copy sent to Capt. W. L. Fisk, Corps of Engineers, January 4, 1892.

20. Bridge of the North River Bridge Company across Hudson River near Twenty-third Street, New York City.—Act of Congress approved July 11, 1890.

Plan and location submitted by the company December 1, 1890, were considered by The Board of Engineers, whose report thereon of April 23, 1891, approved by the Secretary of War April 29, 1891, was adverse to the plans as presented. It was the opinion of the Board, concurred in by the War Department, that the proposed bridge, if located in the vicinity of Twenty-third street, should have a clear headway at the middle of the span above high water of spring tides of not less than 150 feet under any conditions of load or temperature; and at the towers of not less than 140 feet (see Annual Report, Chief of Engineers, 1891, pages 433 and 3853).

November 17, 1891, the company submitted plans modified so as to conform with the requirements as to height fixed by the War Department; these plans and the location were approved by the Secretary of War December 29, 1891; copy sent to Lieut. Col. G. L. Gillespie, Corps of Engineers, January 4, 1892.

21. Bridge of the Lake Shore and Michigan Southern Railway Company across Sandusky Bay, Ohio.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Ohio.

Plan and location submitted by the company October 24 and December 24, 1891; approved by the Secretary of War January 16, 1892; copy sent to Lieut. Col. Jared A. Smith, Corps of Engineers, January 19, 1892.

It is understood that the railway company proposes to construct a draw span with a clear opening of 65 feet, instead of 60 feet, as provided in the approved plan.

22. Bridge of the Chicago, Milwaukee and St. Paul Railway Company across Portage Canal, connecting Fox and Wisconsin rivers, near Portage City, Wisconsin.—Plan for bridge to replace the existing structure submitted by the company December 18, 1891; approved by the Secretary of War January 20, 1892; copy sent to Maj. James F. Gregory, Corps of Engineers, January 23, 1892.

23. Bridge of the city of Oshkosh, Wisconsin, across Fox River at Wis-

consin avenue in Oshkosh.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Wisconsin.

Plan and location submitted by the city December 30, 1891; approved by the Secretary of War February 1, 1892; copy sent to Maj. James F. Gregory, Corps of Engineers, February 3, 1892.

24. *Bridge of the city of Manitowoc, Wisconsin, across Manitowoc River at foot of Eighth street, Manitowoc.*—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Wisconsin.

Plan for new bridge to replace the existing structure received March 5, 1892; approved by the Secretary of War March 8, 1892; copy sent to Maj. James F. Gregory, Corps of Engineers, March 9, 1892.

25. *Bridge of Wahkiakum County, Washington, across Alger (or Brooks) Slough.*—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Washington.

Plan and location submitted by the Board of County Commissioners January 6, 1892; approved by the Secretary of War March 19, 1892; copy sent to Capt. Thomas W. Symons, Corps of Engineers, March 23, 1892.

Capt. Symons reported, June 25, 1892, the completion of this bridge in practical accordance with the approved plan.

26. *Bridge of the Milwaukee, Lake Shore and Western Railway Company across Wolf River at New London, Wisconsin.*—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Wisconsin.

Plans for new bridge to replace existing structure submitted by the company February 12, 1892; approved by the Secretary of War March 22, 1892; copy sent to Maj. James F. Gregory, Corps of Engineers, March 25, 1892.

27. *Bridge of Plymouth and Barnstable counties, Massachusetts, across Cohasset Narrows, so called, between towns of Wareham and Bourne.*—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Massachusetts.

Plan and location submitted by the County Commissioners February 2, 1892; approved by the Secretary of War April 14, 1892; copy sent to Capt. W. H. Bixby, Corps of Engineers, April 18, 1892.

28. *Bridge of the Chicago, Milwaukee and St. Paul Railway Company across Chippewa River, near Red Cedar, Wisconsin.*—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Wisconsin.

Plan for new bridge to replace existing structure submitted by the company February 10, 1892; approved by the Secretary of War April 16, 1892; copy sent to Maj. W. A. Jones, Corps of Engineers, April 20, 1892.

29. *Bridge of the Kenton County and Campbell County Bridge Company across Licking River between Newport and Covington, Kentucky.*—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Kentucky.

Plan and location submitted by the company December 7, 1891; approved by the Secretary of War April 20, 1892; copy sent to Maj. Amos Stickney, Corps of Engineers, April 23, 1892.

On August 10, 1892, the Secretary of War approved plans for false works to be erected during the construction of the bridge, the false works and all obstructions to be removed by October 1, 1892.

30. *Bridge of Skagit County, Washington, across Swinomish Slough.*—

Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Washington.

Plan and location submitted by the Board of County Commissionees September 8, 1891, and January 16, 1892; approved by the Secretary of War April 21, 1892; copy sent to Capt. Thomas W. Symons, Corps of Engineers, April 23, 1892.

31. Bridge of the Washington and Chesapeake Beach Railway Company across Patuxent River at Mt. Calvert, near Bristol Landing, Maryland.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Maryland.

Plan and location submitted by the company April 6, 1892; approved by the Secretary of War April 26, 1892; copy sent to Maj. Charles E. L. B. Davis, Corps of Engineers, April 27, 1892.

32. Bridge of the Washington and Arlington Railway Company across Potomac River at the "Three Sisters," near Washington, District of Columbia.—Act of Congress approved February 28, 1891.

Plan and location submitted by the company March 25, 1892; approved by the Secretary of War April 27, 1892; copy sent to Maj. Charles E. L. B. Davis, Corps of Engineers, April 29, 1892.

33. Bridge of the Leavenworth and Platte County Bridge Company across Missouri River at Leavenworth, Kansas.—Acts of Congress approved February 25, 1889, and July 25, 1890.

Plan for bridge to be located at Cherokee Street, Leavenworth, was approved by the Secretary of War September 25, 1890 (see Annual Report, Chief of Engineers, 1891, page 428, and Annual Report, Chief of Engineers, 1889, page 372). On March 18 and April 21, 1892, application was submitted for authority to change the location from Cherokee Street to Choctaw Street, in Leavenworth; approved by the Secretary of War April 27, 1892; copy sent to Lieut. Col. Chas. R. Suter, Corps of Engineers, April 29, 1892.

34. Bridge of Warren County, Mississippi, across Big Black River at Baldwin Ferry, about 15 miles east of Vicksburg.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Mississippi.

Plan and location submitted by the board of supervisors April 4, 1892; approved by the Secretary of War April 28, 1892; copy sent to Capt. J. H. Willard, Corps of Engineers, April 30, 1892.

35. Bridge of Sagadahoc County, Maine, at Phippsburg, across Atkins Bay, Kennebec River.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Maine.

On July 30, 1891, the county commissioners applied for approval of plan and location of the proposed bridge. On May 2, 1892, the Secretary of War, in letter to the attorney representing the county, stated that as there appeared to be no traffic on Atkins Bay except such as was carried on by boats that could pass under an ordinary pile bridge, no objection would be interposed by the War Department to the construction of the bridge, and also called attention to the provisions of law which would require action by the Department should the bridge at any time prove an unreasonable obstruction to navigation. A copy of the letter of the Secretary of War was sent to Lieut. Col. Peter C. Hains, Corps of Engineers, June 27, 1892.

36. Bridge of Chehalis County, Washington, across Chehalis River at the Elbow Riffle, Washington.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Washington.

Plan and location submitted by the Board of County Commissioners

March 17, 1892; approved by the Secretary of War May 14, 1892; copy sent to Capt. Thomas W. Symons, Corps of Engineers, June 2, 1892.

37. Temporary and permanent bridges of the New York Central and Hudson River Railroad Company across Harlem River at Fourth Avenue, New York City.—River and harbor act approved September 19, 1890, and act of the legislature of the State of New York.

Notice dated July 2, 1890, was served on the company, requiring alteration of this bridge (see Annual Report, Chief of Engineers, 1890, pages 344 and 3484). To meet the requirements of this notice and the provisions of the act of September 19, 1890, relating to bridges over Harlem River, and under the necessary authority from the State of New York, plans for the construction of a temporary and a permanent structure to replace this bridge at a higher grade were submitted by the company January 29 and February 18, 1892. The plans for the temporary bridge were approved by the Secretary of War May 27, 1892; copy sent to Lieut. Col. G. L. Gillespie, Corps of Engineers, June 4, 1892. The plans for the permanent bridge were approved by the Secretary of War August 5, 1892; copy sent to Lieut. Col. Gillespie August 12, 1892.

38. Bridge of the Land and River Improvement Company of Everett across Snohomish River, at Everett, Washington.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Washington.

Plan and location received from the company February 20, 1892; approved by the Secretary of War June 2, 1892; copy sent to Capt. Thomas W. Symons, Corps of Engineers, June 4, 1892.

39. Bridge of the city of Chicago, Illinois, across West Fork of South Branch of Chicago River on Southwest boulevard.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Illinois.

Plan and location submitted by the West Chicago park commissioners March 9, 1892; approved by the Secretary of War June 21, 1892; copy sent to Capt. W. L. Marshall, Corps of Engineers, June 23, 1892.

40. Temporary foot bridge of Messrs. Hugh N. Camp and D. E. Seybel across Harlem River at Broadway extended, New York City.—Permission to build this bridge at the point indicated, asked for May 26, 1892, was granted by the Secretary of War June 24, 1892, by revocable license. Copy sent to Lieut. Col. G. L. Gillespie, Corps of Engineers, June 28, 1892.

41. Temporary bridge of city of New York across Harlem River at One hundred and fifty-sixth street.—Permission to build a temporary bridge at this point, for the purpose of accommodating traffic during the construction of the permanent bridge at One hundred and fifty-fifth street (plans approved September 7, 1891), was asked for by the commissioners of public parks of New York City June 14, 1892, and granted by the Secretary of War by revocable license July 5, 1892, the temporary structure to be removed upon completion of the bridge at One hundred and fifty-fifth street. Copy sent to Lieut. Col. G. L. Gillespie, Corps of Engineers, July 7, 1892.

42. Bridge of the Macon, Dublin and Savannah Railroad Company across Ocmulgee River at Macon, Georgia.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Georgia.

Plan and location submitted by the company May 31, 1892; approved by the Secretary of War July 5, 1892; copy sent to Capt. O. M. Carter, Corps of Engineers, July 7, 1892.

43. Bridge of the town of Milbridge, Maine, across Narraguagus River at Milbridge, Maine.—River and harbor act approved September 19, 1890.

Plans for alteration of the "Great Bridge" at this point submitted by the bridge commissioners May 16, 1892; approved by the Secretary of War July 7, 1892; copy sent to Lieut. Col. Peter C. Hains, Corps of Engineers, July 11, 1892.

44. Bridge of the United Railroads of Washington across South Arm of Willapa River, Washington.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Washington.

Plan and location submitted by the company May 12, 1892; approved by the Secretary of War July 7, 1892; copy sent to Capt. Thomas W. Symons, Corps of Engineers, July 9, 1892.

45. Bridges of the city of Boston, Massachusetts, across Charles River at Market and Arsenal streets.—River and harbor act approved September 19, 1890.

Plans for rebuilding the drawways submitted by the acting mayor June 18, 1892; approved by the Secretary of War July 20, 1892; copy sent to Lieut. Col. S. M. Mansfield, Corps of Engineers, July 28, 1892.

46. Bridge of the Jacksonville, Tampa and Key West Railway Company across Saint Johns River at Buffalo Bluff, Florida.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Florida.

Plan and location for new bridge to replace existing structure submitted by the company May 21, 1892; approved by the Secretary of War July 20, 1892; copy sent to Maj. J. C. Mallery, Corps of Engineers, July 23, 1892.

47. Bridge of Galveston County, Texas, across West Bay from Galveston Island to Virginia Point.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Texas.

Plan and location submitted by the county attorney June 14, 1892; approved by the Secretary of War July 20, 1892; copy sent to Maj. Charles J. Allen, Corps of Engineers, July 23, 1892.

48. Bridge of Skagit County, Washington, across Skagit River at Mount Vernon.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Washington.

Plan and location submitted by the county commissioners March 19, 1892; and modified plans submitted May 28, 1892; approved by the Secretary of War July 25, 1892; copy sent to Capt. Thomas W. Symons, Corps of Engineers, July 29, 1892.

49. Bridge of the Cincinnati and Covington Rapid Transit Bridge Company across Ohio River between Covington, Kentucky, and Cincinnati, Ohio.—Acts of Congress approved December 17, 1872, and February 14, 1883.

Plan and location submitted by the company December 2, 1891, were, under the requirements of the laws, referred to a Board of Engineers for consideration and report; and plans modified to conform to the requirements stipulated by the Secretary of War, based upon the report of the Board, were submitted June 14, 1892. The location and modified plan were approved by the Secretary of War July 27, 1892, and copy was sent to Maj. Amos Stickney, Corps of Engineers, August 2, 1892.

50. Bridge of the St. Paul, Minneapolis and Manitoba Railway Company across Snohomish River near Snohomish City, Washington.—Section

7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Washington.

Plan and location submitted by the company May 7, 1892, and modified plan submitted June 16, 1892; approved by the Secretary of War July 28, 1892; copy sent to Capt. Thomas W. Symons, Corps of Engineers, August 4, 1892.

51. Bridge of Allegheny Bridge Company across Allegheny River at Sixth street, Pittsburg, Pennsylvania.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Pennsylvania.

Plan and location for this bridge were approved by the Assistant Secretary of War May 2, 1891 (see Annual Report, Chief of Engineers, 1891, page 431). On July 21, 1892, the contractors submitted plan for erection of false work in the river during the progress of the work, which was approved by the Secretary of War August 4, 1892, the false work to be removed as soon as practicable.

52. Bridge of Whatcom County, Washington, across Nooksack River at Ferndale.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Washington.

Plan and location submitted by the county commissioners February 9, 1892; approved by the Secretary of War August 4, 1892; copy sent to Capt. Thomas W. Symons, Corps of Engineers, August 6, 1892.

53. Bridge of Whatcom County, Washington, across Nooksack River, at Lynden.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Washington.

Plan and location submitted by the county commissioners February 9, 1892; approved by the Secretary of War August 4, 1892; copy sent to Capt. Thomas W. Symons, Corps of Engineers, August 8, 1892.

54. Bridge of the Albemarle and Raleigh Railroad Company across Tar River at Tarboro, North Carolina.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of North Carolina.

Plan and location for new bridge to replace old structure at this locality received July 20, 1892; approved by the Secretary of War August 8, 1892; copy sent to Maj. W. S. Stanton, Corps of Engineers, August 12, 1892.

55. Bridge of the Kanawha and Michigan (Ohio) Railway Company across Gauley River, in Fayette County, West Virginia.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of West Virginia.

Plan and location submitted by the company May 31, 1892, and modified plan submitted July 8, 1892; approved by the Secretary of War August 11, 1892; copy sent to Col. William P. Craighill, Corps of Engineers, August 16, 1892.

56. Bridge of the Boston Bridge Company across Youghiogheny River at Boston, Pennsylvania.—Section 3 of river and harbor act approved July 13, 1892, and act of the legislature of the State of Pennsylvania.

Plan and location submitted by the company July 16, 1892; approved by the Secretary of War August 15, 1892; copy sent to Maj. Amos Stickney, Corps of Engineers, August 18, 1892.

57. Bridge of Chehalis County, Washington, across South Bay, Elk River, between Bay City and Laidlaw.—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Washington.

Plan submitted by the county commissioners April 12, 1892, and modified plan submitted May 31, 1892; approved by the Secretary of

War August 15, 1892; copy sent to Capt. Thomas W. Symons, Corps of Engineers, August 18, 1892.

58. *Bridge of the Washington, Alexandria and Mount Vernon Electric Railway Company across Hunting Creek at Alexandria, Virginia.*—Section 3 of river and harbor act approved July 13, 1892, and act of the legislature of the State of Virginia.

Plan and location submitted by the company July 21, 1892; approved by the Secretary of War August 20, 1892, on condition that the company will increase the width of the draw-opening to 40 feet when the change is so desired by the Secretary of War; copy sent to Maj. Chas. E. L. B. Davis, Corps of Engineers, August 25, 1892.

59. *Bridges of Brazoria County, Texas, across Bastrop Bayou and Chocolate Bayou.*—Section 3 of river and harbor act approved July 13, 1892, and act of the legislature of the State of Texas.

Plans and locations for these two bridges submitted June 22, 1892; approved by the Secretary of War August 24, 1892; copy sent to Maj. Charles J. Allen, Corps of Engineers, August 27, 1892.

60. *Bridges of the city of Portland, Oregon, across Willamette River at Burnside and Knight-Quimby streets.*—Section 7 of river and harbor act approved September 19, 1890, and act of the legislature of the State of Oregon.

On April 6, 1892, the bridge committee of the city of Portland, Oregon, submitted, for approval by the Secretary of War, plans for two drawbridges to be erected across Willamette River, one at Burnside street, the other at Knight and Quimby streets, under the authority of an act of the State of Oregon. The matter was referred to a Board of Engineers consisting of Maj. Thomas H. Handbury, Capt. Thomas W. Symons, and Lieut. Harry Taylor, Corps of Engineers, for investigation and report. After full consideration of the facts in the case and of statements and arguments presented by the interests concerned, a public hearing being held, the Board submitted its report under date of June 13, 1892, adverse to the bridge projects and recommending that the plans and locations be not approved by the Secretary of War; this recommendation was concurred in by the Chief of Engineers.

The plans and locations were approved by the Secretary of War August 24, 1892; copy sent to Maj. Thomas H. Handbury, Corps of Engineers, August 27, 1892.

To comply with a resolution of the Senate dated June 20, 1892, a copy of the report of the Board and accompanying papers was transmitted to the Senate and printed as Senate Ex. Doc. No. 118, Fifty-second Congress, first session. A copy of the report is also submitted herewith as Appendix Y Y 2.

61. *Bridge of the Chicago, Peoria and Saint Louis Railway Company across Illinois River at Havana, Illinois.*—Act of Congress approved June 6, 1892.

Plan and location submitted June 25, 1892; approved by the Secretary of War August 27, 1892; copy sent to Capt. W. L. Marshall, Corps of Engineers, September 1, 1892.

62. *Bridge of the Chicago and Northwestern Railway Company across Fox River and Government Canal at De Pere, Wisconsin.*—Section 3 of river and harbor act approved July 13, 1892, and act of the legislature of the State of Wisconsin.

Plan and location submitted by the company June 15, 1892, and modified plan submitted July 28, 1892; approved by the Secretary of War August 30, 1892; copy sent to Maj. James F. Gregory, Corps of Engineers, September 1, 1892.

63. *Bridge of the Relief Bridge Company across Allegheny River at Oil City, Pennsylvania.*—Section 3 of river and harbor act approved July 13, 1892, and act of the legislature of the State of Pennsylvania.

Plan and location submitted by the company July 25, 1892; approved by the Secretary of War September 1, 1892; copy sent to Maj. Amos Stickney, Corps of Engineers, September 3, 1892.

64. *Bridge of the Kewaunee, Green Bay and Western Railroad Company across Kewaunee River at Kewaunee, Wisconsin.*—Section 3 of river and harbor act approved July 13, 1892, and act of the legislature of the State of Wisconsin.

Plan and location submitted by the company August 10, 1892; approved by the Secretary of War September 6, 1892; copy sent to Maj. James F. Gregory, Corps of Engineers, September 10, 1892.

65. *Bridge of the city of Napa, California, across Napa River.*—Section 3 of river and harbor act approved July 13, 1892, and act of the legislature of the State of California.

Plan for new bridge to replace the old one at this locality submitted by the Board of Trustees August 2, 1892; approved by the Secretary of War September 6, 1892; copy sent to Lieut. Col. W. H. H. Benyaurd, Corps of Engineers, September 10, 1892.

66. *Bridge of the city of Milwaukee, Wisconsin, across Kinnickinnic River at Clinton street.*—Section 3 of river and harbor act approved July 13, 1892, and act of the legislature of the State of Wisconsin.

Plan and location for new bridge to replace old structure submitted by the city engineer July 20, 1892; approved by the Secretary of War September 12, 1892; copy sent to Maj. James F. Gregory, Corps of Engineers, September 15, 1892.

PROPOSED BRIDGE OF CITY OF DULUTH, MINNESOTA, ACROSS CANAL AT ENTRANCE OF DULUTH HARBOR.

On January 26, 1892, the authorities of the city of Duluth, Minn., submitted, for approval by the Secretary of War, plans for a lift bridge proposed to be erected across the canal at the entrance of Duluth Harbor under the authority of an act of the State of Minnesota. The matter was referred to a Board of Engineers consisting of Col. O. M. Poe, Maj. William Ludlow, and Maj. W. A. Jones, Corps of Engineers, for investigation and report. After full consideration of the facts in the case and of statements presented at a public hearing, fully advertised, of all the interests concerned, the Board submitted its report, dated April 6, 1892, and in accordance with its recommendations, which were concurred in by the Chief of Engineers, the plans of the bridge were on April 11, 1892, disapproved by the Secretary of War.

To comply with a resolution of the Senate, dated April 12, 1892, a copy of the report of the Board and accompanying papers was transmitted to the Senate and printed as Senate Ex. Doc. No. 80, Fifty-second Congress, first session. A copy of the report is also submitted herewith as Appendix Y Y 1.

BRIDGES OBSTRUCTING NAVIGATION.

Under the requirements of sections 4 and 5 of the river and harbor act approved September 19, 1890, the Secretary of War notified the persons, corporations, or associations owning or controlling certain bridges obstructing navigation, after giving them a reasonable opportunity to be heard, to so alter said bridges as to render navigation through or under them reasonably free, easy, and unobstructed, specifying in the notice the alterations required to be made, and prescribing a reasonable time in which to make them, as follows:

1. *County bridge across the Kentucky River at St. Clair street, Frankfort, Kentucky.*—Notices, dated September 8, 1891, served on the judge of the county court of the county of Frankfort, Ky., September 26, 1892, and the mayor of the city of Frankfort, Ky., October 6, 1891. Alterations required: Raising the bridge to a clear height of 48 feet 4 inches above the normal level of Pool 4 of the Kentucky River, and providing it with a channel span having a clear water way of not less than 150 feet at normal pool level. Alteration to be made and completed on or before September 1, 1892.

2. *Society Hill and Marlborough Bridge Company's bridge across the Great Pedee River near Society Hill, South Carolina.*—Notice dated September 8, 1891, served on the president of the bridge company September 24, 1891. Alterations required: A double line of piles to be driven above the bridge from the pier supporting the end of the fixed span for a distance of 150 feet, the piles in each line to be 12 feet apart, and the two lines 8 feet apart, and the piles to be thoroughly braced with waling and pieces and diagonal braces. From the center pier the fender to be built both above and below the draw span of sufficient length to prevent a passing steamer from swinging under either half of the open draw span; the construction above the pier to be similar to that above described, and below the pier to be of a single line of piles. In the draw opening itself two fender piles to be driven on each side of the draw to protect the center pier and the pier supporting the fixed span from actual contact with passing steamers. Alterations to be made and completed on or before September 1, 1892.

3. *Bridge across the St. Joseph River, Michigan, near its mouth.*—Notices, dated December 10, 1891, served on the president of the Chicago and West Michigan Railway Company December 17, 1891. Alterations required: (1) Through the existing draw opening of the bridge. Removal of all obstructions to navigation in the existing draw passages of the bridge to the full depth of 15 feet, to the full width of both passages, and to the full extent to which the draw structure occupies the water way. Alteration to be made and completed on or before May 15, 1892. (2) North channel through the bridge. Opening of the navigation of the north channel in the harbor by the construction of a suitable draw 70 feet in clear width of opening, its location to be about 200 feet from the north shore to the south side of the draw. Alteration to be made and completed on or before November 1, 1892.

4. *Bridge across Tulls Creek at Tulls, North Carolina.*—Notice dated February 17, 1892, served on the chairman of the board of commissioners of Currituck County, N. C., March 14, 1892. Alteration required: (1) Repairing the rotating apparatus of the draw so that it can be easily turned. (2) Constructing suitable fenders of piles and planking above and below the draw opening to prevent collisions by passing boats. Alteration to be made and completed on or before June 1, 1892.

The alterations have been completed.

5. *Highway bridge across the Casper (Gasper) River, near its mouth, Kentucky.*—Notice dated February 24, 1892, served on the county judge of Warren County, Ky., March 7, 1892. Alteration required: The bridge to be raised 6 feet so as to make its clear height above pool level 24.60 feet. Alteration to be made and completed on or before July 1, 1892.

6. *Drawbridge across Newtown Creek at Meeker avenue, Brooklyn, New*

York.—Notices, dated April 11, 1892, served on the chairman of the boards of supervisors of Kings and Queens counties April 20, 1892, and May 13, 1892, respectively. Alterations required: The removal of those parts of the existing solid abutments which project beyond the legal bulkhead lines, the widening of existing draws to 65 feet in the clear on each side of the pivot pier, and the opening of a water way 20 feet wide approximately along the bulkhead line on each shore. Alterations to be made and completed on or before October 1, 1892.

7. *Highway bridge across the Chippewa River at Durand, Wisconsin.*—Notice dated May 7, 1892, served on the president of the Chippewa Valley Bridge Company May 13, 1892. Alteration required: Construction of a sheer boom 200 feet long, extending up stream from the draw-rest pier and supported by two cribs, one at the upper end and the other 75 feet therefrom; the said boom to be 4 feet wide, and 1 foot deep and located on the prolongation of a line drawn tangent to the west faces of the pivot and draw-rest piers. Alteration to be made and completed on or before June 16, 1892. A flood occurred on the Chippewa during the month of May, in consequence of which, and the great quantity of loose logs in the river, the time for completing the work was extended to December 15, 1892.

8. *Bridge across Coopers Creek at Federal street, Camden, New Jersey.*—Notices, dated May 7, 1892, served on the director of the board of freeholders of Camden, N. J., and the president of the Camden Horse Railroad Company, May 12, 1892. Alteration required: The board of freeholders to reconstruct the draw of the bridge, with a clear opening of 40 feet, so that it can be operated with facility; and the railroad company to remove the electric trolley wire from above the draw span over the bridge. Alteration to be made and completed on or before September 30, 1892.

9. *Railroad bridge across Commencement Bay at Tacoma, Washington.*—Notice, dated June 3, 1892, served on the president of the Northern Pacific Railroad Company June 9, 1892. Alteration required: Providing a draw having clear openings on each side of the pivot pier of not less than 125 feet in the clear and a draw rest extending to the full length and width of the draw span when open, both up and down stream. Alteration to be made and completed on or before March 1, 1893.

10. *Railroad bridge across Buffalo Bayou at Houston, Texas.*—Notice, dated June 27, 1892, served on the vice-president of the Gulf, Colorado and Santa Fe Railway Company July 11, 1892. Alteration required: Lines of fender piles to be placed as indicated by red dotted lines on map attached to the notice, the total length of the lines of piling to be 167 feet on the right bank and 115 feet on the left bank; the piles to be 5 feet apart between centers and to be cut off at an elevation of 13 feet above mean low water, to be well driven and to be strongly connected with one another on the shore side by two lines of stringpieces placed horizontally, the whole well braced by timbers bolted at intervals to the fender piling and to a second row of piles between the fender piles and the bank; all the piling or other obstructions on the channel sides of the fender piling that have been placed by the railway company to be removed, and a cap to be placed on the projecting timbers of the abutment as indicated in red on the drawing. Alteration to be made and completed within three months from date of service of notice.

11. *San Jacinto street highway bridge across Buffalo Bayou at Houston, Texas.*—Notice, dated June 27, 1892, served on the mayor of the city of Houston, Tex., July 14, 1892. Alteration required: A line 40 feet long of fender piles to be placed on the right bank, connecting the bank

with the upstream pier as shown by red dotted line on map attached to the notice; four piles to be placed between the piers on the right bank as also shown on the map; the piles to be cut off at an elevation of 13 feet above mean low water, to be 5 feet apart between centers, well driven and to be strongly connected with one another on the shore side by two lines of stringpieces placed horizontally, the whole well braced by timbers bolted at intervals to the fender piling and to a second row of piles between the fender piles and the bank. Alteration to be made and completed within three months from date of service of notice.

OCCUPANCY OF AND INJURY TO PUBLIC WORKS BY CORPORATIONS AND INDIVIDUALS.

Under the requirements of section 2 of the river and harbor act approved July 5, 1884, and section 4 of the river and harbor act approved August 5, 1886, there are submitted herewith reports of officers in charge of river and harbor districts of instances in which piers, breakwaters, or other works built by the United States in aid of commerce or navigation are used, occupied, or injured by corporations or individuals.

(See Appendix Z Z.)

MISCELLANEOUS.

[Public works not provided for in acts making appropriations for the construction, repair, and preservation of works on rivers and harbors.]

MAINTENANCE AND REPAIR OF WASHINGTON AQUEDUCT—WATER SUPPLY, DISTRICT OF COLUMBIA, ACT MARCH 2, 1889—INCREASING THE WATER SUPPLY OF WASHINGTON, DISTRICT OF COLUMBIA—ERECTION OF FISHWAYS AT THE GREAT FALLS OF THE POTOMAC.

Officer in charge, Lieut. Col. George H. Elliot, Corps of Engineers.

1. *Washington Aqueduct.*—The masonry dam at Great Falls is in good condition. Some of the riprap back filling that had been carried away by ice in the previous fiscal year could not be replaced by reason of the inadequacy of the appropriation for preservation and repair and the pressure of more immediately important work.

The feeder at the head of the conduit at Great Falls has been cleaned out several times during the year.

The trunk mains that lead from the distributing reservoir and supply the distributing system of mains that are under the care of the Commissioners of the District of Columbia are in excellent condition. A break occurred in the main in K street east, but it was not extensive and was repaired at small expense. No other serious leaks occurred during the year. An extension of the blow-off in the 48-inch main near M street bridge was extended to Rock Creek by means of 20-inch cast-iron pipe and the outlet of the blow-off on the 36-inch main at Foundry Branch was repaired.

A serious leak of from 30,000 to 40,000 gallons a day that existed for some years near Cabin John Bridge has been stopped, and the officer in charge, taking advantage of the opportunity presented by the necessary emptying of the conduit for making the repair, made a thorough inspection of the whole length of the interior of the conduit from Great Falls to the distributing reservoir on the 1st of September last. A full account of the results of it may be found in his report. As was to have been expected, large deposits of silt and sediment, the accumulations of nearly thirty years, and estimated at more than 15,000 cubic yards, were found in the conduit. The masonry of the conduit was generally found to be in excellent condition, but there are several cracks in the conduit arch. As a general rule these were found where the conduit was built on high embankments at the culverts and where settlement doubtless took place soon after the conduit was constructed. None of the cracks leak except one at culvert No. 26, and from none of them is any present danger to the conduit to be apprehended. They will be repaired as soon as the conduit can be cleaned out and money can be had for the purpose. Considerable progress has been made in the removal of the deposits, but as the work which must be done while the water is cut off at Great Falls and the conduit is emptied is done mainly at night, it is expensive and tedious.

The annual appropriations for the maintenance and repair of the aqueduct, and the reservoirs, mains, roads, etc., connected with it, are so small that the work of removing the deposits can not be done without neglect of other necessary work, and, even with this neglect, to finish the work by means of these appropriations would require many years. A special estimate of $14,000, which would enable the entire conduit to be cleaned out in one year, is included in the estimates for the next fiscal year.

Several times during the year, when the water on the dam at Great Falls was low, and also during the times the water from Great Falls was cut off to enable the work of cleaning out the conduit to be carried on, it was found necessary to reënforce the distributing reservoir by the water of the receiving reservoir and the three streams that flow into it.

The surveys and marking by monuments of the boundaries of the aqueduct lands, both in the District of Columbia and in Maryland, have been continued.

The conduit manholes, 66 in number, mainly under the Conduit road, were uncovered and their distances from reference stones along the road were measured for future use when the manholes are opened for cleaning out accumulation of deposits or for repairs. It was found that several of the casings of the manholes should be raised. Nine of the reference stones that were missing have been replaced by new ones.

The work of erecting strong guard fences at the high embankments on the Conduit road was continued; 3,200 feet of these fences was built in the fiscal year, making 7,464 feet, or about 1½ miles, in all.

Improvements were made in the approaches to wasteweirs Nos. 1 and 2 and in the means of controlling the water at wasteweir No. 3. New frames for the two waste gates set in the wall under the weir were built and a leak that has existed at wasteweir No. 1 for several years was stopped.

Repairs were made to the pavement of the Conduit road, which was made for the protection of the conduit under the road, at many places, but the appropriation for preservation and repair is not sufficient to keep the entire pavement in as thorough repair as is desired. The officer in charge suggests that this beautiful drive, which is, the major part of it, beyond the District line, is worthy of a special appropriation for its improvement and adornment by sodding of the slopes, planting of trees, etc., but as this work is not strictly necessary for the purposes of the aqueduct, he does not include it among his annual estimates.

The bridges are in good condition with the exception of the bridge over the spillway from the receiving reservoir, and the floors of Griffith Park and Cabin John bridges. A new bridge of masonry is required to replace the old wooden bridge at the former place, and Griffith Park and Cabin John bridges should be paved with granite blocks.

The officer in charge renews his request for an appropriation for the additional works required for restoring to use the receiving reservoir for the double purpose of improving the quality of our Potomac water by relieving it of the muddiness that it has in winter and spring, and of regaining the capacity for the storage of Potomac water that was lost when this important reservoir, which has a capacity of about 175,000,000 gallons, was thrown out of service by reason of the pollution by some small streams that lead into it; for the further improvement of the quality of the Potomac water by lowering the height of the cross dam at the distributing reservoir; for the protection of the inlet to the aqueduct at Great Falls; for extending an important wasteweir, which is liable to be obstructed by the private owners of adjacent land; for cleaning out the distributing reservoir, and for the purchase or condemnation of a site for a storage yard for supplies for use in case of breaks in mains.

He also calls attention to the necessity of widening and deepening the spillway from the receiving reservoir; of rebuilding the bridge over this spillway; of repaving Griffith Park and Cabin John bridges; of a storehouse at Great Falls; of protecting the conduit at wasteweir No. 1; of inserting air valves and blow-off valves in the old mains, and of completing the removal of the accumulation of deposits from the conduit as soon as money can be obtained for the purpose.

These objects and the desired general provision of law relating to appropriations for the Washington Aqueduct, as well as the small increase asked for in the general appropriation for preservation and repair of the aqueduct and its accessory works, are of great importance, and the renewal of the recommendations of the officer in charge in respect of them is concurred in.

July 1, 1891, balance unexpended	$23,944.25
June 30, 1892, amount expended during fiscal year	21,705.74
July 1, 1892, balance unexpended	2,238.51
July 1, 1892, outstanding liabilities	2,238.51

The estimates of the officer in charge for the fiscal year ending June 30, 1894, are as follows:

For improving the receiving reservoir by the works required for cutting off the drainage into it of polluted water and sewerage from the surrounding country for the purchase or condemnation of the small amount of land required for the purpose, and for the excavation necessary at the head of the reservoir	$150,000
For improving the receiving reservoir by deepening its margins and protecting them by slope walls	140,625
For lowering the height of the cross dam at the distributing reservoir	12,500
For protecting the inlet to the aqueduct at Great Falls	5,000
For extending the outlet of wasteweir No. 3	2,500
For purchase or condemnation of a site for a storage yard	10,000
For cleaning out the distributing reservoir	13,825
For widening and deepening the spillway at the receiving reservoir	2,000
For repaving Griffith Park and Cabin John bridges	5,000
For storehouse at Great Falls	1,500
For protecting the conduit at wasteweir No. 1, near Great Falls	5,000
For inserting air valves and blow-off valves in the 36-inch and 30-inch mains	6,250
For removing the accumulation of deposits in the conduit	14,000
For rebuilding the bridge over the spillway at the receiving reservoir	18,000
For maintenance and repairs of the aqueduct, the reservoirs, mains, roads, etc., connected therewith	21,000
Total	407,200

(See Appendix A A A 1.)

2. *Water supply, District of Columbia; the 48-inch main.*—The work of laying the 48-inch main, for which $575,000 was appropriated by the act of March 2, 1889, the laying of the 30-inch mains in East Capitol street and in New Jersey avenue Northwest, and the 24-inch mains in Eleventh street Northwest, in K street Northeast, and in Eighteenth street Northwest, which were done by means of the same appropriation, had been completed at the close of the last fiscal year.

The remainder of the appropriation, amounting to $10,669.91, remaining in the hands of the officer in charge, was turned into the Treasury on the 9th of September, 1891.

July 1, 1891, balance unexpended	$10,866.58
June 30, 1892, amount expended during fiscal year	196.67
July 1, 1892, balance unexpended	10,669.91
July 1, 1892, outstanding liabilities	81.40
July 1, 1892, balance available	10,588.51

As far as can be foreseen the available remainder of the appropriation will not be required for future expenditure.

(See Appendix A A A 2.)

3. *Increasing the water supply of Washington, District of Columbia.*—This work was commenced under an appropriation made in the act of Congress approved July 15, 1882.

All operations on this project are suspended, and no work has been done under it during the year.

The work of replacing the decayed timber linings of the upper portions of the tunnel shafts, which was in operation at the close of the last fiscal year, was continued, and completed early in the year. The work consisted in making an entirely new lining of the best quality of Georgia pine, extending either from the surface of the rock, as at Foundry Branch shaft (which was completed in the previous fiscal year) and Champlain avenue shaft, or from the top of the brick lining that had been carried at the Howard University shaft to within about 20 feet of the surface of the ground.

At Foundry Branch shaft the new lining was of 3-inch plank set behind horizontal frames of 10-inch by 12-inch timbers 2 feet apart. At Champlain avenue and Howard University shafts the lining was built solid of 10-inch by 12-inch timbers.

The interior stone lining, "pitching," of the new reservoir near Howard University having been considerably injured by drainage water from ground around the reservoir, which found its way to the bottom of the reservoir under the stone and undermined it, it was found necessary to cut off these streams, and several small retaining walls were built to prevent further damage. About 715 square yards of the stone lining of the reservoir, which had sunk from the washing out of the sand under it, was repaired. A guard strainer, 6 feet square, composed of 2-inch Georgia pine plank, was built around the inlet mouth of the 12-inch drain under the dam to prevent a possible disastrous obstruction of this drain. A masonry wing wall was built on each side of the mouth of the great sewer which passes around this reservoir for the protection of the mouth, and the earth which had been washed away refilled back of the wall and over the sewer.

A watchman has been employed during the year at the new reservoir. His duties have included the guarding of the stone at the mouths of all of the shafts except the one at Foundry Branch, which is under the care of the watchman at the distributing reservoir.

July 1, 1891, balance unexpended on all items of appropriation	$433, 792. 47
June 30, 1892, amount expended during fiscal year	3, 466. 94
July 1, 1892, balance unexpended	430, 325. 53
July 1, 1892, outstanding liabilities	146. 08
July 1, 1892, balance available	430, 179. 45

No estimate for further appropriation is submitted.

(See Appendix A A A 3.)

4. *Erection of fishways at Great Falls.*—At the commencement of the fiscal year operations were in progress under the contract entered into June 9, 1891, with Isaac H. Hathaway, of Philadelphia, Pa., for the construction of fishways at Great Falls, the plans and specifications for which had been prepared by the Commissioner of Fish and Fisheries, as contemplated by the act making appropriations for the same.

By direction of the Secretary of War, the engineer officer in charge is held responsible only for the proper protection of the aqueduct dam at Great Falls and for the disbursement of the funds appropriated.

The Commissioner of Fish and Fisheries having discovered that his plans for section 6 of the fishways were not adapted to the site of the work, new plans and specifications were prepared by him for this section, and on the 10th of September a supplemental contract was entered into with the contractor for the work under the new plans for section 6.

By the terms of the contract the work was to have been completed before December 12, 1891; but the contractor, finding that this would be impracticable, asked for an extension of time to July 1, 1892, and this was granted him; the additional expense to the United States by reason of such extension being deducted on final settlement, as provided for in the contract.

By reason of the uncertainties as to the amounts of excavation, concrete, and riprap work that would be found to be required to completely finish sections 4, 5, and 6 of the fishways, and of a doubt whether all of this work and the superstructure of section 4 could be completed, as was greatly to be desired, before the next spring freshets, with the appropriation available for the fishways, after paying the contractor the amount then due him (the contract provided that the excavation, the concrete, and the riprap were to be done at rates per cubic yard), it was deemed advisable to enter into a supplemental contract with the contractor to completely finish section 4, and to finish all the work remaining to be done on sections 5 and 6 at a lump sum which was within the amount of the appropriation remaining available. This agreement was entered into on the 22d of December, 1891.

There remain to be done sections 1, 2, and 3 to complete the fishways, for which the Commissioner will prepare modified plans, and for which $15,000 was included in the estimates submitted in my last annual report.

July 1, 1891, balance unexpended	$29, 874. 18
June 30, 1892, amount expended during fiscal year	29, 826. 29
July 1, 1892, balance unexpended	47. 89
July 1, 1892, outstanding liabilities	2. 93
July 1, 1892, balance available	44. 96

(See Appendix A A A 4.)

IMPROVEMENT AND CARE OF PUBLIC BUILDINGS AND GROUNDS, AND CARE AND MAINTENANCE OF THE WASHINGTON MONUMENT, IN THE DISTRICT OF COLUMBIA.

Officer in charge, Col. O. H. Ernst, major, Corps of Engineers.

The various improved parks and reservations have received the care and attention required to maintain them in good condition.

The Washington Monument received necessary attention. A new set of cables for the elevator was placed, and the improvement of the surrounding grounds was completed as far as available funds would permit.

Additional buildings were erected in the nursery grounds. About 486,000 plants were propagated in the greenhouses during the year, nearly all of which were set out in the public grounds in May and June.

In the Smithsonian grounds and Judiciary Square additional asphalt road pavement and footwalks were constructed. In Lafayette Square additional asphalt footwalk was laid.

A granite curbing was placed around Lafayette Square. A granolithic pavement was laid upon the sidewalk on Pennsylvania avenue in front of the Executive Mansion grounds.

McPherson Square was entirely remodeled.

Reservation No. 34, on the north side of Pennsylvania avenue between Seventh and Eighth streets west, was also remodeled.

Reservation No. 20, at the intersection of Pennsylvania avenue, Twenty-eighth and M streets northwest, was improved.

The circle at the intersection of Massachusetts and New Jersey avenues and First and G streets northwest was inclosed with an iron post-and-chain fence, and some trees were planted.

Eight hundred and forty-three feet of additional water pipe was laid in different parts of the public grounds during the year.

In the Executive Mansion some floors of Portland cement were laid in the basement, extensive improvements were made in the laundry and the bath-rooms, some of the apartments were redecorated, new carpets and window draperies purchased, some of the furniture renovated, and the work of introducing electric lights completed. The stone balustrade above the cornice on the east end of the Mansion and a portion of the east porch were considerably damaged by a severe storm in November. Necessary repairs were made to the greenhouses connected with the Mansion.

Attention is invited to the detailed report of the officer in charge, and to his estimates for the coming fiscal year, as follows:

For improvement and care of public buildings and grounds		$184,022
For compensation of persons employed on public buildings and grounds		55,680
For replacing the overhead system of telegraph wires with duplicate six-conductor underground cable, and for care and repair of existing lines		32,500
For contingent and incidental expenses of public buildings and grounds		500
For care of Washington Monument and maintenance of elevator:		
Salaries of employés	$9,060	
Fuel, light, contingencies, etc	3,600	
		12,660
		285,362

(See Appendix B B B.)

PRINTING AND DISTRIBUTION OF CHARTS OF THE NORTHERN AND NORTHWESTERN LAKES, AND SURVEYS MADE FOR THE PURPOSE OF KEEPING THESE CHARTS UP TO DATE.

Under the supervision of this office additions have been made to the engraved copper plates of charts of—

Lake Superior, Nos. 1, 2, and 3;
River Ste. Marie, Nos. 1 and 2;
Straits of Mackinac;
North end of Lake Michigan;
South end of Lake Michigan;
Beaver Island group, Lake Michigan;
North end of Green Bay;
South end of Green Bay;
Lake Michigan coast chart Nos. 2, 3, 5, 6, 7, 8, and 9;
Grand and Little Traverse bays, Lake Michigan;
Lake Huron;
Saginaw Bay;
Detroit River;
Lake Erie;
Lake Erie coast chart Nos. 2, 3, 4, and 5;
Lake Ontario coast chart Nos. 2 and 5;
St. Lawrence River, No. 4;
St. Lawrence River, No. 5.

Corrections and additions to quite a number of other plates have been ordered, and work thereon is progressing.

During the year 5,801 charts were distributed under the supervision of Col. O. M. Poe, Corps of Engineers, at Detroit, Mich.; of these 5,113 were sold at 20 cents each, and 19 at 10 cents each, and the amount of $1,024.50 turned into the Treasury. In addition, 19 charts at 20 cents each were sold at this office, and the sum of $3.80 was deposited in the Treasury. The total amount received for the sale of charts was, therefore, $1,028.30. The total appropriation for printing and distributing these charts was only $2,000.

Were it not for the fact that the distribution is made from an office already organized for river and harbor work, the necessary supply of charts could not be printed and distributed with so small an appropriation.

During the fiscal year surveys were made as follows:

St. Marys River from White Fish Bay to Detour Light-House.—A project for this survey having been submitted at an estimated cost of $64,080, orders were given directing Col. Poe to expend the available balance of the appropriation in commencing the work. Active operations were begun May 22, 1892. By the close of the fiscal year a base line had been measured, the triangulation was planned starting from the base line through six stations, and angles at four of these stations were satisfactorily measured; observations were made for primary azimuth; a line of precise levels was run from St. Marys Falls Canal lock to Bay Mills on the Lake Superior level; a water gauge was established at this latter point, and observations taken to determine the fall in the water surface above the canal; hydrographic work was begun in the vicinity of Sailors Encampment, and considerable progress was made. Every possible use has been made of all former work done in this locality, at the time the river was originally surveyed and charted, and also at the time of the river improvement survey of 1879; the records of both surveys are in the hands of the Engineer Department, and all duplication of Government work is thus avoided. A number of instruments formerly used by the survey were put in good condition and shipped to the locality, and everything is now in readiness to push the work to completion and issue new charts of the river as quickly as possible.

Shoals off Pelée Spit Light-House, and Littles Point, Lake Erie.—Information with regard to dangerous shoals in these localities having been received, estimates for their survey were made, amounting to $1,000 and $610 respectively. Allotments of these amounts having been made from the appropriation, Col. Poe was directed to proceed with the work. Active operations were prevented by unfavorable weather until May 20, 1892, when a lake survey party left Detroit for the localities of the shoals. This party remained in the field until the close of the fiscal year, being very much delayed by heavy weather. Their work was entirely completed, however, a new and very dangerous shoal having been located off Point Pelée, Ontario, and less water being found on the shoal off Littles Point than had previously been discovered.

(See Appendix C C C 1.)

Waverly Shoal, Lake Erie.—The survey of this shoal was made in the latter part of September, 1891. For details see report of Maj. Amos Stickney, Corps of Engineers, dated January 16, 1892.

(See Appendix C C C 2.)

Shoals in the St. Lawrence River.—Surveys of reported shoal places in the St. Lawrence River, made under the direction of Maj. M. B. Adams, Corps of Engineers, have developed six shoals, two east of the northern end of Grenadier Island, two below Crossover Light-House, one S. by W. ¼ W. of Coles Ferry Light-House, and one SSE. ¼ E. of the same point.

The bottom of the St. Lawrence River is very irregular, and obstructions are apt to remain undiscovered even though numerous soundings have been made. Considering the great and growing importance of the commerce, it would be well to thoroughly sweep the navigable channels to give assurance of the nonexistence of undiscovered obstructions within a depth of 20 feet below the surface. This work must be left to the future when sufficient funds become available.

(See Appendix C C C 3.)

Discharges of Niagara River.—Measurements of discharges have been made and the results will be published after the observations have been reduced.

Resurvey of the lake front at Chicago.—A resurvey of this front was ordered so as to show the changes wrought in the hydrography since the former survey and to show in greater detail the conformation of the reefs and shoals along the city front and landings. The immediate reason for the survey was that all obstructions and dangers could be buoyed and marked for the safety of the great numbers of passengers who, it is to be supposed, will visit the grounds of the World's Columbian Exposition in 1893, by means of steamers, etc., from the various landings along the city front. The survey and the plotting of the notes are progressing under the supervision of Capt. W. L. Marshall, Corps of Engineers.

(See Appendix C C C 4.)

Survey of Black Creek Shoal, Lake Ontario.—This survey was made in October last, and the details are given in the report of Capt. Dan C. Kingman, Corps of Engineers, dated October 28, 1891.

(See Appendix C C C 5.)

An effort has been made to keep all the charts up to date. A number have been corrected, and in some cases where certain special examinations have been required, the only practicable way to make them has been in connection with river and harbor improvements in the immediate vicinity. This very important work has been seriously impeded by lack of funds.

As soon as the funds available will permit it is proposed to prepare and publish general charts of lakes Superior and Michigan, each on one sheet, there being a great demand for these charts at present; also to prepare and publish coast charts of lakes Huron and Superior in order to complete the set of charts of the lakes.

These projects or something of a similar nature will have to be carried out if the charts are to be rendered of the greatest service to navigators. The work already done, particularly the location of the dangerous shoals in Lake Erie, has fully demonstrated the necessity which exists for work of this character. The lake marine is of too great importance to the country at large for any effort looking towards its safety to be spared. When the Government sells charts to navigators these charts should embody the latest and most accurate information concerning the localities to which they refer, and everything should be done to render navigation safe and certain.

The low water of recent years combined with the great increase in size and number of vessels has resulted in the larger and more expensive vessels discovering dangers previously unknown, and discovering them by the costly process of striking them. All dangers so discovered should at once be surveyed and located upon the charts in order to prevent the repetition of similar accidents at the same point. Localities deemed perfectly safe for navigation when smaller vessels were used are now regarded with suspicion by the larger vessels, and it is essential that certain special areas should be reëxamined.

St. Marys River is one of the localities on the lakes where new surveys are essential in order that the charts may be rendered of the greatest service; the surveys upon which the present charts are based were made between 1853 and 1857, and since that time the region tributary to the river has undergone an enormous development. More than 9,000,000 tons of freight now pass through the river annually, and extensive works of improvement have been completed and are in progress. Since the original surveys were made the draft of vessels has increased from 9½ and 12 feet to 16 feet and will shortly be increased to 20 feet. The river is a difficult one to navigate with the large vessels of the present time, and new charts are absolutely essential. The records of the former survey and of the river improvement will prevent all duplication of work, and will permit the survey to be pushed to completion as quickly as possible.

The organized districts in connection with river and harbor work now established at the chief cities on the lakes will greatly facilitate keeping all of the charts up to date, and will insure the maximum results with the minimum cost.

In view of the great importance of this work to the lake marine an appropriation of $50,000 for surveys and other expenses connected with correcting and extending the charts of the northern and northwestern lakes is most earnestly recommended, as the conditions now existing are urgent and require that this amount should be available at the earliest possible moment, and an appropriation of $3,000 is recommended for the printing and distribution of the charts.

(See Appendix C C C 1.)

Annual water levels of the northern and northwestern lakes.—Tables and diagrams showing the monthly means of water levels from July 1, 1887, to June 30, 1892, at Charlotte, Lake Ontario; and Oswego (from June 30, 1890), Erie, and Cleveland, Lake Erie; Milwaukee, Lake Michigan; Escanaba, Green Bay; Sand Beach, Lake Huron; Marquette, Lake Superior; and Sault Ste. Marie, being in continuation of those published in the Annual Report of the Chief of Engineers for 1887, will be found in Appendix C C C 6.

CONSTRUCTION AND IMPROVEMENT OF ROADS AND BRIDGES IN YELLOWSTONE NATIONAL PARK.

Officer in charge, Maj. William A. Jones, Corps of Engineers, with Lieut. Hiram M. Chittenden, Corps of Engineers, under his immediate orders; Division Engineer, Col. O. M. Poe, Corps of Engineers.

The construction of roads and bridges in the Yellowstone National Park was commenced in a systematic manner in 1883, when the direction of the work was placed in the hands of an officer of the Corps of Engineers. A number of small appropriations had been expended in the endeavor to make it possible to reach the main objects of interest; access was rendered possible, but only after a tiresome trip attended with considerable danger. Since 1883 the work has remained in the charge of the Engineer Department.

At the outset the engineers adopted a project which has since been followed. It embraces a belt-line road, commencing at Gardiner, on the north boundary line of the park; thence to Mammoth Hot Springs; thence to Upper Geyser Basin via Norris Geyser and Lower Geyser basins; thence to the outlet of Yellowstone Lake via Shoshone Lake and the west arm of Yellowstone Lake, crossing the Continental Divide of the Rocky Mountains twice; thence to Yancey via the Falls and Grand Canyon of the Yellowstone River; thence to Mammoth Hot Springs, completing a circuit of about 145 miles. There are also included in the project a road from the west boundary line of the park to intersect the road along the Yellowstone River between the lake outlet and the falls, via Lower Geyser Basin; a road from Norris Geyser Basin to the falls of the Yellowstone; a road from Yancey to the east line of the park, and short branch roads to points of interest, comprising in all about 225 miles of new roads with necessary bridges and culverts. Estimated costs as revised in 1889, $444,779.42.

The act of Congress approved March 3, 1891, changed the project of the part of the belt line between Lower Geyser Basin and Yellowstone Lake by requiring the road to be built "by the shortest practicable route" from Fountain Geyser to the thumb of Yellowstone Lake. This change did not materially affect the cost.

At the beginning of the year 62.85 miles of new roads had been constructed, which, in connection with parts of old roads kept in condition, enabled tourists to visit Mammoth Hot Springs, Norris Geyser Basin, Lower Geyser Basin, and Upper Geyser Basin, and the Falls and upper end of the Grand Canyon of the Yellowstone River. A commencement by contract work had been made toward opening up the Shoshone and Yellowstone lakes regions to travelers.

Total amount expended upon the project since commencement of work in 1883, to June 30, 1891, including outstanding liabilities, $259,779.42.

Contracts had been entered into May 16, 1891, with Wyatt & Scott, for 7.5 miles, and William Z. Partello for 20.3 miles, *i. e.*, from the thumb of Yellowstone Lake to the Grand Canyon via the lake outlet. Messrs. Wyatt & Scott prosecuted their contract to completion. Mr.

Partello failed to enter upon his contract, but the officer in charge had anticipated such action and was prepared to carry on the work by day's labor, which he did.

In addition, the construction of the road from Fountain Geyser to the thumb of Yellowstone Lake, "by the shortest practicable route," was carried on by day's labor. By the close of the season of 1891 all of the above roads were completed, except two short sections which were opened sufficiently for travel, thus opening to tourists the last 53 miles of that part of the belt line commencing at Norris Geyser Basin; thence to Upper Geyser Basin via Lower Geyser Basin; thence to the thumb of Yellowstone Lake, "by the shortest practicable route;" thence to the Grand Canyon via Yellowstone Lake outlet; thence to Norris Geyser Basin.

The estimates of "amount required for existing projects," which are annually submitted, only apply to the construction of new roads. They do not cover current-repairs and maintenance. It is proposed to apply the sum of $150,000 asked for towards graveling weak places in completed roads; graveling new roads; completing road between Grand Canyon, Yancey, and Mammoth Hot Springs; repairs and maintenance of completed roads and old wagon trails.

Amount expended during fiscal year ending June 30, 1892, including outstanding liabilities, $75,000.

July 1, 1891, balance unexpended	$132,980.73
June 30, 1892, amount expended during fiscal year	132,885.81
July 1, 1892, balance unexpended	94.92
July 1, 1892, outstanding liabilities	94.92
Amount (estimated) required for completion of existing project	197,000.00
Amount that can be profitably expended in fiscal ending June 30, 1894	150,000.00

(See Appendix D D D.)

MILITARY AND OTHER MAPS.

The following maps and plans have been photolithographed and an edition printed:

Map of pier head and bulkhead lines for the west shore of Upper New York Bay from Jersey City to Constables Point, N. J.

Map of pier head and bulkhead lines for the south shores of Raritan and Sandy Hook bays from the mouth of Cheesequake Creek to Highland Bridge across Shrewsbury River, New Jersey.

Map of pier head and bulkhead lines for Gravesend Bay, New York Harbor, from Fort Hamilton to western end of Coney Island, New York.

Map of pier head and bulkhead lines for Great and Little Mill rocks and the Government dike connecting them, Hell Gate, New York.

Map of Boston Harbor, Massachusetts. Charles River from Market Street bridge to the Watertown dam. Boston Harbor Line Board, sheet N.

Map of Boston Harbor, Massachusetts. South Boston Flats. Boston Harbor Line Board, Sheet O.

Davis Island lock and dam, Ohio River, in 12 sheets.

Detail drawings of lock and dam, No. 7, Great Kanawha River, West Virginia, in 15 sheets.

Detail drawings of Kampsville lock and dam, Illinois River, Illinois, in 14 sheets.

Map of the Department of the Columbia, 4th edition, 1892.

Map of the Department of Dakota, 1891.

RECONNAISSANCES AND EXPLORATIONS.

The following officers have been on duty at the headquarters of the military departments engaged in preparing such maps and making such surveys as were required by their respective commanding officers:

Capt. William L. Marshall, Corps of Engineers, at headquarters Department of the Missouri until April 23, 1892, since which date Lieut. Cassius E. Gillette, Corps of Engineers.

Capt. Charles H. Clark, Ordnance Department, at headquarters Department of the Columbia until September 4, 1892, since which date Maj. Tully McCrea, Fifth U. S. Artillery.

Capt. Charles A. Worden, Seventh U. S. Infantry, at headquarters Department of the Platte.

Lieut. James E. Runcie, First U. S. Artillery, at headquarters Department of California until April 3, 1892; Lieut. Leonard A. Lovering, Fourth U. S. Infantry, until May 16, 1892; since which date Lieut. Charles G. Lyman, Second U. S. Cavalry.

Lieut. Cassius E. Gillette, Corps of Engineers, engineer officer Department of the Missouri, reports that no fieldwork has been done during the year, and that the office work has consisted in the preparation of maps, tracings, reproductions, etc., for use of the department commander and other officers connected with department headquarters, the most important of the work having been in connection with the campaign against hostile Sioux of Dakota, 1890–'91.

(See Appendix E E E 1.)

Maj. Tully McCrea, Fifth U. S. Artillery, acting engineer officer Department of the Columbia, reports that operations included minor surveys on the Vancouver Barracks military reservation, having reference to the location of roads and fences, and the preparation of plans for the extension of the sewerage system. Maps, tracings, and solar prints have been prepared and issued as required for official purposes, and additions have been made to the military maps of the department as new information became available.

(See Appendix E E E 2.)

Capt. Charles A. Worden, Seventh U. S. Infantry, acting engineer officer Department of the Platte, reports that a survey was made in October, 1891, of the northern, eastern, and southern boundary lines of the Fort Omaha military reservation. Work has been continued on the compilation of the map of the department east of the 103d meridian, which will be completed for reproduction and publication in a few weeks. Instruments have been received from the engineer depot, Willets Point, N. Y., and instruments, note books, maps, tracings, and blue prints have been supplied to the various posts from time to time. Maps of the department west of the 103d meridian, and large-scale blue print maps of northwestern Wyoming have also been issued to troops in the field.

(See Appendix E E E 3.)

Lieut. Charles G. Lyman, Second U. S. Cavalry, in charge of engineer office Department of California, reports that the office work involved the preparation of original drawings, tracings, and blue prints, coloring, mounting, and distribution of maps, the care and preservation of surveying and other instruments in store and issuing the same for use at the different posts and to the quartermaster's department. No fieldwork of any importance has been entered into during the year.

(See Appendix E E E 4.)

ESTIMATES FOR AMOUNTS REQUIRED FOR SURVEYS AND RECONNAISSANCES IN MILITARY DEPARTMENTS, AND FOR MAPS, INCLUSIVE OF WAR MAPS.

For military surveys and reconnaissances and surveys of military reservations by the engineer officers attached to the several headquarters of military departments, being an average of $2,142.86 for each of seven military departments west of the Mississippi River, $15,000; for publication of maps for use of the War Department, inclusive of war maps, $10,000; total, $25,000.

Attention is specially invited to this estimate for appropriation and to the important uses for which it is intended.

At the headquarters of the military departments west of the Mississippi River there are stationed officers of the Corps of Engineers, or other officers detailed to act, whose duty it is to make reconnaissances for military purposes, to make such surveys and prepare such maps as may be required by their respective commanding officers. In recent years no appropriations have been made for these purposes, and, consequently these officers have been very much cramped from lack of the necessary means, and the usefulness of their offices has been very much reduced in consequence. The maps of these departments are constantly in need of revision and additions, which the officers make so far as possible, but with no means even for the purchase of paper their efforts are limited in results.

Paragraph 383 of the Army Regulations requires that the commanding officer of each post where there are fixed batteries bearing upon a channel will call upon the Engineer Department for accurate charts showing the soundings to the extent of the ranges of the guns. Calls upon this department to perform its duty under this regulation can not be honored from lack of means.

Maps of certain military departments are now being prepared and should be published.

Of the 1,100 copies of each map printed under the act alluded to, all those not printed in this office (47 sheets) have been exhausted for some time, and the calls for them can only be honored with sets deficient in that number of sheets.

Besides all this, there is much information in this office relative to military geography which could with little expense be made available for the information of officers of the Army; for instance, there are on the office files detailed maps of regions of Europe which may become at an early day the theaters of war, and it would be of great advantage to the service if such information as these maps give could be made available for the study of officers, especially on the outbreak of hostilities. Were the means provided, this office would be glad to compile and to disseminate the information on its files.

It is the policy of this country to keep a standing army small in numbers, but it is its expectation that it should be a highly instructed one, and a small outlay as here referred to will be conducive to that end.

Applications from officers of the Army have been received for maps of certain regions of Europe, and it was with great regret that this office could not render this assistance to officers desirous of improving themselves professionally, especially when the material was on its files.

OFFICE OF THE CHIEF OF ENGINEERS.

During the fiscal year ending June 30, 1892, the following-named officers were in charge of the several divisions of the office of the Chief of Engineers:

FIRST DIVISION.—*Fortifications and Surveys relating thereto—Arma-*

ment of Fortifications—Sites for Engineer Defenses—Boards of Engineers for Defenses—Military Reservations—Land files—Public Buildings and Grounds—Washington Aqueduct—Roads and Bridges in Yellowstone National Park.

SECOND DIVISION.—*Battalion of Engineers—United States Engineer School and Engineer Depot and Post—Professional Papers and Information—Personnel—Orders.*

Capt. John G. D. Knight.

THIRD DIVISION.—*Improvement of Rivers and Harbors and Surveys relating thereto—Bridging Navigable Waters of the United States—The removal of Wrecks Obstructing Navigation.*

Maj. Henry M. Adams.

FOURTH DIVISION.—*Accounts for Disbursements—Contracts—Returns of Engineer Property and Instruments—Application for Remittances—Appropriations and Estimates—Blank Forms.*

FIFTH DIVISION.—*Survey of the Lakes—Explorations and Surveys—Reconnaissances—Maps—Instruments—Claims.*

Capt. Thomas Turtle.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

HON. S. B. ELKINS,
Secretary of War.

STATEMENT SHOWING THE RANK AND THE DUTIES OF OFFICERS OF THE CORPS OF ENGINEERS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

RANK AND NAME.	DUTIES.
BRIGADIER GENERAL AND CHIEF OF ENGINEERS.	
Thos. Lincoln Casey....	In command of the Corps of Engineers and in charge of the Engineer Department. Charged with the supervision of such matters connected with construction of jetties and other works at South Pass, Mississippi River, as require the action of the Secretary of War. In charge of the construction of the building for Library of Congress under act of October 2, 1888. Member of Rock Creek Park Commission by virtue of act of Congress approved September 27, 1890. Member of the Lighthouse Board.
COLONELS.	
George H. Mendell	Division Engineer of the Pacific Division. Member of The Board of Engineers when it is acting upon matters pertaining to the defensive works of the Pacific coast. In charge of the defensive works at Alcatraz Island, at Lime Point, Fort Winfield Scott, and Battery at Fort Mason, in San Francisco Bay; and of the Battery at San Diego, Cal. In charge of construction of gun and mortar batteries for defense of San Francisco, and of a torpedo shed at Yerba Buena Island, San Francisco Harbor, Cal. In charge of the improvement of Oakland Harbor, Cal. In charge of survey of San Francisco Harbor, San Pablo and Suisun bays, Strait of Carquinez, and mouths of San Joaquin and Sacramento rivers, Cal. To act as a judge of the character of the earth discovered by borings being made by the Treasury Department at San Francisco, Cal. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines of San Francisco and San Diego harbors and adjacent waters, and at San Pedro, Cal.; and at Portland, Oregon; on deep-water harbor on the Pacific coast, between points Duma and Capistrano, and on ship canal to connect lakes Union, Washington, and Samamish with Puget Sound; to consider and report upon the subject of the harbor lines of Olympia, Vancouver, and Bellingham Bay, and at Port Townsend, Port Angeles, Anacortes, Aberdeen, Ocosta, Ballard, Seattle, Edmonds, Sidney, Hoquiam, South Bend, Tacoma, Steilacoom, Blaine, Cosmopolis, Ilwaco, and La Conner, Wash. Member of Board of Officers for the examination for promotion of certain officers of the Corps of Engineers; and to report on a site for a military post and harbor defenses at or near San Diego, Cal.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
COLONELS. (continued.)	
Henry L. Abbot *Bvt. Brig. General.*	Division Engineer of the Northeast Division. Member and president of the Board of Engineers. In charge of certain experiments with torpedoes. Member of Board of Ordnance and Fortification. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines of the port of Boston, of New York Harbor and its adjacent waters, and at Oswego, N. Y. Member of Board of Officers for the examination for promotion of certain officers of the Corps of Engineers.
William P. Craighill	Division Engineer of the Southeast Division. In charge of the defensive works at Forts Carroll and McHenry, Baltimore, Md. In charge of the improvement of the harbor at Baltimore, Md. In charge of the improvement of James River, Va., New River, Va. and W. Va., and Gauley, Great Kanawha, and Elk rivers, W. Va. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines of New York Harbor and its adjacent waters; of the port of Philadelphia; in James River from Richmond to City Point, Va.; the dam to be built in the Big Sandy River near Louisa, Ky.; and a project for a lock at the mouth of Bayou Plaquemine, La.; to consider and report upon plan for superstructure of the breakwater for a national harbor of refuge at Sandy Bay, Cape Ann, Mass.; and to consider and report upon the subject of the harbor lines in the Anacostia River, from its mouth to Bennings Bridge. Member of Commission of Engineer Officers on national harbor of refuge near the mouth of Delaware Bay. Member of the Light-house Board.
Cyrus B. Comstock *Bvt. Brig. General.*	Division Engineer of the Southwest Division. Member of The Board of Engineers. Member of Board of Visitors for U. S. Engineer School. Member and president of the Mississippi River Commission, created by act of Congress approved June 28, 1879. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines of New York Harbor and its adjacent waters, and of the port of Philadelphia. Member of Board of Officers for the examination for promotion of certain officers of the Corps of Engineers. To represent the War Department at the Fifth Congress of Internal Navigation, to be held in Paris, France, in July, 1892.
Orlando M. Poe *Bvt. Brig. General.*	Division Engineer of the Northwest Division. In charge of the defensive works at Fort Wayne, Mich. In charge of the improvement of the harbors at Cheboygan, Au Sable, and at Thunder Bay; harbor of refuge at Sand Beach; of the St. Marys River at the Falls; of the St. Clair Flats Ship Canal; and of the rivers Detroit, Saginaw, Clinton, and Rouge, Thunder Bay River, Alpena, Black River at Port Huron, and mouth of Black River, Mich., and Hay Lake Channel of the St. Marys River; construction of dry dock. St. Marys Falls Canal, and of dredging at Grosse Pointe Channel. In charge of St. Clair Flats Ship Canal and St. Marys Falls Canal, Mich. In charge of issuing charts of Northern and Northwestern Lakes, and of water-level observations on Lake Huron. In charge of survey of shoal off Littles Point, and shoal off Pelée Spit Light, Lake Erie. In charge of removal of wreck of coal vessel *M. E. Tremble* in the rapids of St. Clair River at Fort Gratiot, Mich., and of wreck of scow *Hannah Moore* at mouth of Black River,

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
COLONELS. (continued.)	
Orlando M. Poe *Bvt. Brig. General.*	Ohio. Member of Boards of Engineer Officers to consider and report upon the subject of harbor lines at Cleveland, Ohio; at Detroit, Mich.; to examine and report upon the plans of a bridge over the entrance to Duluth Harbor, Minn.; and to consider and report upon the location of the western terminus of the Illinois and Mississippi Canal. Engineer Ninth and Eleventh Light-house districts. Member of General Court-Martial convened at Cleveland, Ohio, February 3, 1892.
David C. Houston	Member of The Board of Engineers. In charge of the defensive works at forts Griswold, Trumbull, and Hale, Conn., Columbus, Wood, Wadsworth, and Tompkins, and its batteries, N. Y.; Castle Williams, South Battery, new Barbette Battery at Governors Island, N. Y.; of Sea wall at same; of Sea wall at Davids Island, N. Y.; and of permanent platforms for modern cannon of large caliber. In charge of construction of gun batteries on Staten Island for defense of New York. In charge of the improvement of the harbors of New London, Clinton, New Haven, Milford, Bridgeport, Black Rock, Stamford, Norwalk, Five Mile River, and Wilsons Point, Conn., and Greenport, Port Chester, Glen Cove, Echo Harbor, Flushin Bay, Port Jefferson Inlet, Larchmont, and Huntington, N. Y.; of the construction of breakwaters at New Haven, and harbor of refuge, Duck Island Harbor, Conn. In charge of the improvement of the Housatonic River and for breakwater, Thames and Mystic rivers, Conn., Connecticut, Mass., and Conn., East Chester Creek, Patchogue River, and Browns Creek, N. Y. In charge of survey of Sag Harbor and Peconic River, N. Y., Stamford Harbor, and Cos Cob or Miamus River, Conn., and examination of Mattituck Bay, N. Y. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines of New York Harbor and its adjacent waters; of Stamford Harbor; at Norwalk, and at Bridgeport, Conn. Member of Board of Officers for the examination for promotion of certain officers of the Corps of Engineers. Member of Board of Visitors for U. S. Engineer School.
LIEUTENANT-COLONELS.	
George H. Elliot	In charge of the Washington Aqueduct; increasing water supply of the city of Washington, and of the disbursement of the funds pertaining to the erection of fish-ways at Great Falls of the Potomac. Member of Board of Engineer Officers to consider and report upon the subject of the harbor lines in the Anacostia River from its mouth to Bennings Bridge. Member of the Light-house Board.
Henry M. Robert	Detached; Engineer Commissioner of the District of Columbia. In charge of the improvement of the rivers Tennessee above Chattanooga, Tenn., and below Bee Tree Shoals, Cumberland above and below Nashville, Ky., and Tenn., Hiawassee, Caney Fork, French Broad, and Clinch, Tenn., and South Fork of the Cumberland, Ky. To exercise supervision over the construction of bridges across the Tennessee River at or near Chattanooga; at Knoxville; at or near Knoxville; at Perryville; and at Johnsonville, Tenn.

Statement showing rank and duties of officers of Corp of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
LIEUTENANT-COLONELS. (continued.)	
William E. Merrill *Bvt. Colonel.*	In charge of the improvement of the Ohio River, Monongahela and Cheat rivers, W. Va., Allegheny River, Pa., and of the Muskingum River, Ohio. In charge of the construction of harbor of refuge at mouth of Muskingum River, of a dam at Herrs Island, and of a movable dam at or below the mouth of Beaver River, Pa. In charge of operating snag boats on the Ohio River. To exercise supervision over the construction of bridges across Ohio River between Cincinnati and Newport; near Ceredo, W. Va.; at Wheeling, W. Va.; over Muskingum River, at Stockport; at Zanesville; above the mouth of Brush Creek, Ohio; over the Allegheny River at Pittsburg over Youghiogheny River at McKeesport, and over Monongahela River near Pittsburg, Pa. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines at Pittsburg, Pa., and on the Ohio to Davis Island Dam; on both sides of the Ohio River from the upper end of Martins Ferry to the lower end of the city of Bellaire, Ohio; and at Cincinnati, including the Licking River between its mouth and the bridge of the Louisville and Nashville Railroad. Engineer Fourteenth Light-house District. His death, December 14, 1891, announced in General Orders, No. 9, Headquarters Corps of Engineers, December 17, 1891.
John M. Wilson *Bvt. Colonel.* *Ex officio Colonel of Engineers.*	Detached; Superintendent of the U. S. Military Academy. Member of Board of Officers to witness the final examinations and exercises of the class of officers which will have completed the two years' course of instruction at the U. S. Artillery School on June 21, 1892.
John W. Barlow	In charge of the improvement of the rivers Tennessee above Chattanooga, Tenn., and below Bee Tree Shoals, Cumberland above and below Nashville, Ky., and Tenn., Hiawassee, Caney Fork, French Broad, and Clinch, Tenn., and South Fork of the Cumberland, Ky. In charge of the survey of Obion River, Tenn. To exercise supervision over the construction of bridges across the Tennessee River at or near Chattanooga; at Knoxville; at or near Knoxville, and at Perryville, Tenn. Detached; member and disbursing officer of the International Boundary Commission for the location and marking of the boundary between the United States and Mexico, under the direction of the Secretary of State.
Peter C. Hains	In charge of the defensive works at forts Foote and Washington, Md., Wool and Monroe, Va. In charge of the improvement of the Potomac River in the vicinity of Washington, and of channel in the Eastern Branch, Potomac River. In charge of the improvement of the harbor at Breton Bay, Leonardtown, Md. In charge of the improvement of Putuxent River, Md.; of the rivers Rappahannock, Mattaponi, York, and Pamunkey, and of Nomini, Urbana, Occoquan, and Aquia creeks, Va. In charge of survey of Eastern Branch of Potomac River, Md. and D. C., and of Potomac River, Va. and Md., and examination and survey of a breakwater for harbor of refuge in Lynn Haven Bay, Va. In charge of the construction of the sewerage system at Fort Monroe, Va. to supervise the reconstruction of the Washington shore end of the Long Bridge at Washington, D. C., and the construction of a street railway, and a bridge across Mill Creek at Fort Monroe, Va. Member of Boards of Engineer Officers to consider and report upon the subject

***Statement showing rank and duties of officers of Corps of Engineers*—Cont'd.**

RANK AND NAME.	DUTIES.
LIEUTENANT-COLONELS. (continued.)	
Peter C. Hains	of the harbor lines in James River from Richmond to City Point, Va. In charge of the defensive works at forts Knox, Popham, Gorges, Scammel, Preble, and McClary, batteries at Portland Head and Gerrishs Island, Me., and at Fort Constitution and Jerrys Point, N. H. In charge of the improvement of the harbors at Belfast, Camden, Rockport, Rockland, Portland, York, and Back Cove, Portland Harbor, Me.; Portsmouth, N. H., harbor of refuge at Little Harbor, N. H., and the construction of breakwater from Mount Desert to Porcupine Island, Me. In charge of the improvement of the rivers Penobscot, Kennebunk, Saco, Narragaugus, Bagaduce, Kennebec, Harrisseckit, St. Croix, and Pleasant, Me.; Cocheco and Bellamy, N. H.; Lubec Channel and Mooseabec Bar, Me. In charge of survey of Kennebec River from Waterville to the steamboat wharf at Augusta, Me. In charge of the removal of wreck of schooner *Isabel Alberto* in Rockland Harbor, and part of wreck of schooner *Huntress* off Browneys Island, Me.
George L. Gillespie	Member of The Board of Engineers. In charge of the defensive works at Forts Hamilton and Lafayette, N. Y., and fort at Sandy Hook, N. J. In charge of construction of gun and mortar batteries for defense of New York. In charge of the improvement of the harbors of New York, Rondout, and Saugerties, N. Y., and Raritan Bay, N. J. In charge of the improvement of the Hudson and Harlem rivers, N. Y.; channel in Gowanus Bay, Bay Ridge Channel in Gowanus Bay, and Buttermilk Channel; deepening Gedneys Channel, and Newtown Creek and Bay, and Wappingers Creek, N. Y. In charge of survey of Bushwick Creek, Hudson River at Cornwall, western part of route from main channel from Jamaica Bay easterly to Long Beach Inlet for canal, Bronx River, and Westchester Creek, N. Y. In charge of the removal of obstructions in East River and Hell Gate, N. Y. In charge of removal of wrecks of canal boat in Gravesend Bay; of canal boat in Raritan Bay, near South Amboy, N. J., and of canal boat in Staten Island Sound, at Tottenville, N. Y. To supervise the work of making an opening in the United States dike on the right bank of the Hudson River. To exercise supervision over construction of proposed bridge across the East River between the city of New York and Long Island; of bridge across Harlem River at One hundred and fifty-fifth street, New York City; of bridge across Hudson River in and between the city of New York and the State of New Jersey; of a temporary bridge across Harlem River at Fourth avenue, New York City; of certain work of the Hudson Tunnel Railway Company, and of two piers on the Jersey Flats, New York Bay, at Bayonne, N. J. Member of Board of Visitors for U. S. Engineer School. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines of the port of Boston; of New York Harbor and its adjacent waters; of Stamford Harbor; at Norwalk, and at Bridgeport, Conn; on obstructions to navigation in the Hudson River; and on deep-water harbor on the Pacific coast between Points Duma and Capistrano.
Charles R. Suter	Member of the Mississippi River Commission created by act of Congress approved June 28, 1879. Member and president of the Missouri River Commission created by act of Congress approved July 5, 1884. To exercise su-

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
LIEUTENANT-COLONELS. (continued.)	
Charles R. Suter........	pervision over the construction of two bridges across the Missouri River at or near Sioux City, Iowa; and of bridges opposite to or within the corporate limits of Nebraska City, Nebr.; at or near Nebraska City, Nebr.; at Omaha, Nebr.; between Omaha, Nebr., and Council Bluffs, Iowa; near Council Bluffs, Iowa, and East Omaha, Nebr.; between Kansas City and Sibley, Mo.; between Leavenworth, Kans., and Platte County, Mo.; between Wyandotte County, Kans., and Clay County, Mo.; between Clay and Jackson counties; between St. Charles and the mouth of Missouri River, Mo.; and near Quindaro, Kans.; Engineer fifteenth and sixteenth light-house districts.
Jared A. Smith..........	In charge of the defensive works at Forts Knox, Popham, Gorges, Scammel, Preble, and McClary, Batteries at Portland Head and Gerrishs Island, Me., and at Fort Constitution and Jerrys Point, N. H. In charge of the improvement of the harbors at Belfast, Camden, Rockport, Rockland, Portland, and York, and Back Cove, Portland Harbor, Me., Portsmouth, N. H., harbor of refuge at Little Harbor, N. H., and the construction of breakwater from Mount Desert to Porcupine Island, Me. In charge of the improvement of the rivers Penobscot, Kennebunk, Saco, Narragaugus, Bagaduce, Kennebec, Harrisseckit, St. Croix, and Pleasant, Me., Cocheco and Bellamy, N. H., Lubec Channel and Mooseabec Bar, Me. In charge of survey of Kennebec River from Waterville to the steamboat wharf at Augusta, and Penobscot River, and survey and location of harbor lines at Bath, Me. In charge of removal of wrecks of schooners *Golden Eagle* and *Ceruleus* in Pleasant River, Me., and of steam tug *Wilcox* and of sailboat *Rescue* in the harbor of Port Clinton, Ohio. In charge of the improvement of harbors at Monroe, Mich.; Toledo, Port Clinton, Sandusky, Vermillion, Huron, Cleveland, Fairport, Ashtabula, and mouth of Black River, and of Sandusky River, Ohio. In charge of water-level observations on Lake Erie. To supervise the construction of bridges across Sandusky Bay and across Huron River at Huron, Ohio. Engineer tenth light-house district.
Samuel M. Mansfield....	In charge of the defensive works at Forts Warren, Winthrop, Standish, Andrew, Independence, and on Long Island Head, Mass. In charge of construction of gun and mortar batteries for defense of Boston Harbor. In charge of the improvement of the harbors at Newburyport, Lynn, Boston (including sea walls on Point Allerton, Great Brewster Island, Lovells Island, Gallops Island, Long Island Head, Rainsford Island, and Deer Island; Mystic and Charles rivers; Fort Point Channel, channel leading to Nantasket Beach and Main Ship Channel), Provincetown, Plymouth, Scituate, Hingham, Gloucester, Winthrop, Wellfleet, and Manchester; Salem, including South River, and Stage Harbor at Chatham, Mass. In charge of construction of a national harbor of refuge (of the first class) at Sandy Bay, Cape Ann, Mass. In charge of the improvement of the Merrimac River at Mitchells Falls, Ipswich, Powow, and Weymouth rivers, Mass. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines of the port of Boston; and upon plan for superstructure of the breakwater for a national harbor of refuge at Sandy Bay, Cape Ann, Mass.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
LIEUTENANT-COLONELS. (continued.)	
William R. King	Commanding post and U. S. Engineer School at Willets Point, N. Y., and the Battalion of Engineers. In charge of the defensive works at Fort Schuyler and Willets Point; of the engineer depot at Willets Point; torpedoes for harbor defense, and experiments with the same. In charge of construction of gun and mortar batteries for defense of New York at eastern entrance of harbor. In charge of funds pertaining to the library of the U. S. Engineer School.
William H.H. Benyaurd .	In charge of the defensive works of Alcatraz and Angel islands, and at Lime Point, Cal. In charge of construction of a torpedo station at Yerba Buena Island, San Francisco Harbor, Cal. In charge of the improvement of the harbors at Wilmington and San Diego; and construction of breakwater at San Luis Obispo Harbor, Cal. In charge of the improvement of Napa River and Redwood Creek, Cal. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines of San Francisco and San Diego harbors and adjacent waters, and at San Pedro, Cal., and on deep-water harbor on the Pacific coast between Points Duma and Capistrano. Member of Board of Officers for the examination for promotion of certain officers of the Corps of Engineers.
Garrett J. Lydecker	In charge of the Louisville and Portland Canal. In charge of the improvement of the Falls of the Ohio River, the Indiana Chute Fall, Ohio River, Wabash River, Ind. and Ill., and White River, Ind. To exercise supervision over the construction of bridge across the Ohio River at Louisville, Ky. Member of Board of Engineer Officers to examine and report upon plans of a bridge across the Ohio River between Covington, Ky., and Cincinnati, Ohio.
MAJORS.	
Amos Stickney	In charge of the improvement of the harbors at Erie, Pa., and Buffalo, Wilson, Olcott, Oak Orchard, and Dunkirk, N. Y. In charge of improvement of Tonawanda Harbor and Niagara River, N. Y. In charge of the preservation and protection of the peninsula of Presque Isle, Erie Harbor, Pa. In charge of survey of Port Day above Niagara Falls, N. Y. In charge of survey of Waverly Shoal, Lake Erie, and of measurement of the discharge of Niagara River. Member of Boards of Engineer Officers on obstructions to navigation in the Hudson River; and to consider and report upon the subject of harbor lines at Cleveland, Ohio. Member of general court-martial convened at Cleveland, Ohio, February 3, 1892. In charge of the improvement of the Ohio River, Monongahela and Cheat rivers, W. Va., Allegheny River, Pa., and of the Muskingum River, Ohio. In charge of the construction of harbor of refuge at mouth of Muskingum River, of a dam at Herrs Island, and of a movable dam at or below the mouth of Beaver River, Pa. In charge of operating snag-boats on the Ohio River. To exercise supervision over the construction of bridges across Ohio River near Ceredo, W. Va.; over Muskingum River at Zanesville; above the mouth of Brush Creek, Ohio; over the Allegheny River at Pittsburg; over the Monongahela River at Pittsburg; near Pittsburg; over Youghiogheny River at McKeesport, Pa., and across

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
MAJORS. (continued.)	
Amos Stickney	Licking River between Newport and Covington, Ky. Member of Boards of Engineer Officers to consider and report upon the subject of harbor lines at Pittsburg, Pa., and on the Ohio to Davis Island Dam; on both sides of the Ohio River from the upper end of Martins Ferry to the lower end of the city of Bellaire, Ohio; and at Cincinnati, including the Licking River between its mouth and the bridge of the Louisville and Nashville Railroad; and upon plans of bridge across the Ohio River between Covington, Ky., and Cincinnati, Ohio. Engineer fourteenth light-house district.
Alexander Mackenzie	In charge of the improvement of the Mississippi River from Minneapolis to Des Moines Rapids, and at Rock Island and Des Moines Rapids. In charge of operating the dry dock at the Des Moines Rapids Canal; the Des Moines Rapids Canal and snag-boats and dredge-boats on Upper Mississippi River. In temporary charge of the improvement of the Mississippi River between Des Moines Rapids and the mouth of the Illinois River. To supervise the construction of bridges across the Mississippi River at Muscatine, at Lyons, at or near Clinton, Iowa; at La Crosse, Wis.; at St. Paul; at Winona, Minn., and from Winona, Minn., to the opposite shore in Wisconsin. Member of Board of Engineer Officers to consider and report upon a project for a lock at the mouth of Bayou Plaquemine, La.; and upon the location of the western terminus of the Illinois and Mississippi Canal. Member of the Missouri River Commission created by act of Congress approved July 5, 1884.
Oswald H. Ernst	In charge of Public Buildings and Grounds in the District of Columbia, with the rank of colonel. In charge of the improvements over the grave of Thomas Jefferson at Monticello, Va., and of the erection of a monument to mark the birthplace of George Washington. In charge of the care and maintenance of the Washington Monument. Member of the Mississippi River Commission, created by act of Congress approved June 28, 1879. Member of the Missouri River Commission, created by act of Congress approved July 5, 1884. Member of the Light-House Board.
David P. Heap	Detached; engineer third light-house district.
William Ludlow *Bvt. Lieut. Colonel.*	In charge of the improvement of the harbors at Frankfort, Manistee, Pentwater, White River, Muskegon, Grand Haven, Black Lake, Saugatuck, South Haven, St. Joseph, and Charlevoix, and entrance to Pine Lake and harbors of refuge at Ludington and Portage Lake; breakwater and harbor of refuge, Petoskey Harbor, Mich., and harbor at Michigan City, Ind., and of St. Joseph River, Mich. In charge of survey of Grand River, below Grand Rapids, Mich. To supervise the construction of bridg across Pine Lake, near Charlevoix, Mich. Member of Boards of Engineer Officers to investigate and report upon the alleged obstruction of navigation by a bridge over the Chicago River at Chicago, Ill.; to consider and report upon the subject of harbor lines at Detroit, Mich.; and to examine and report upon the plans of a bridge over the entrance to Duluth Harbor, Minn. Engineer ninth and eleventh light-house districts. Member of general court-martial convened at Cleveland, Ohio, February 3, 1892.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
MAJORS. (continued.)	
William A. Jones.......	In charge of the improvement of the Chippewa River, and protection of Yellow Banks on the same; of the Minnesota and St. Croix rivers, and the Red River of the North; and of the Mississippi River above the Falls of St. Anthony. In charge of construction and improvement of roads and bridges in Yellowstone National Park. In charge of the construction of reservoirs at headwaters of the Mississippi River and its tributaries. In charge of gauging the waters of the Mississippi River and its tributaries at or near St. Paul, Minn. In charge of the examination and surveys of the sources of the Mississippi, St. Croix, Chippewa, and Wisconsin rivers, with the view to ascertaining the practicability and cost of creating and maintaining reservoirs, etc. In charge of survey of Red River, Minn., and tributaries above Fergus Falls and Crookston, and Big Stone Lake. To exercise supervision over construction of bridges across Red River of the North at Alpha, De Mers, and Minnesota avenues, Grand Forks, N. Dak.; and across Chippewa River near Red Cedar, Wis. Member of Board of Engineer Officers to examine and report upon the plans of a bridge over the entrance to Duluth Harbor, Minn.
Andrew N. Damrell.....	In charge of the defensive works at Forts Morgan and Gaines, Ala., and fort on Ship Island, Miss. In charge of the improvement of the harbors at Mobile, Ala., and Biloxi, Miss. In charge of the improvement of the rivers Warrior and Black Warrior, Ala.; Tombigbee, Ala. and Miss.; Pascagoula, Pearl, Noxubee, Chickasahay, and Leaf, and Bluff Creek, Miss., and Bogue Chitto, La. To supervise the construction of bridge across Fort Bayou at Ocean Springs, Miss.
Charles J. Allen	In charge of the improvement of the entrance to Galveston Harbor and of the harbor at Brazos Santiago, Tex. In charge of the improvement of ship-channel in Galveston Bay, Buffalo Bayou, Trinity River, and mouth of Cedar Bayou, Tex. In charge of survey of West Galveston Bay, and examination of Brazos River, Tex.
Charles W. Raymond...	In charge of the defensive works at Fort Mifflin, Pa.; Fort Delaware, and fort opposite Fort Delaware, Del.; at Finns Point, and site for defenses at Red Bank, N. J. In charge of the improvement of the harbors at Philadelphia, Pa., and Delaware Breakwater, Del.; ice-harbors at Marcus Hook, Pa., and the head of Delaware Bay, Del.; of the Schuylkill River, Pa.; Delaware River, from Trenton to its mouth, including Rancocas River; Maurice River and Alloway Creek, N. J., and of the construction of pier near Lewes, Del. In charge of removal of wreck of steamer *Nuphar* in Townsend Inlet, N. J.; of wreck of canal boat *Agatha Brady* opposite Fairmount Avenue Wharf, Delaware River, Philadelphia, Pa.; and of wrecks of steamer *Gaudaloup* and steam-tug *Starlight* in Barnegat Inlet, N. J. In charge of disbursement of funds appropriated for the Trenton Battle Monument. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines of the port of Philadelphia and on obstructions to navigation in the Hudson River; and to consider and report upon plan for superstructure of the breakwater for a national harbor of refuge at Sandy Bay, Cape Ann, Mass. Member of Commission of Engineer Officers on national harbor of refuge near the mouth of Delaware Bay.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
MAJORS. (continued.)	
L. Cooper Overman	In charge of the improvement of harbors at Monroe, Mich., Toledo, Port Clinton, Sandusky, Vermillion, Huron, Cleveland, Fairport, Ashtabula, and mouth of Black River; and of Sandusky River, Ohio. In charge of water-level observations on Lake Erie. In charge of survey of Conneaut Harbor, and Grand River between Richmond and the mouth, Ohio. Member of Board of Engineer Officers to consider and report upon the subject of harbor lines at Cleveland, Ohio. Engineer tenth light-house district. In charge of the defensive works at forts Foote and Washington, Md.; Wool and Monroe, Va. In charge of the improvement of the Potomac River in the vicinity of Washington, and of channel in the eastern branch, Potomac River. In charge of the improvement of Patuxent River, Md., of the rivers Rappahannock, Mattaponi, York, and Pamunkey, and of Nomini, Urbana, Occoquan, and Aquia creeks, Va. In charge of the construction of the sewerage system at Fort Monroe, Va. To supervise the reconstruction of the Washington shore end of the "Long Bridge" at Washington, D. C., and the construction of a street railway, and a bridge across Mill Creek, at Fort Monroe, Va. Awaiting orders December 8, 1891, June 23, 1892. On leave of absence.
Alexander M. Miller	In charge of the improvement of the Mississippi River—removal of snags, etc.; Mississippi River between the mouths of the Illinois and Ohio rivers; and harbor at St. Louis, Mo., Osage River, Mo. and Kans., Gasconade River, Mo., and Kaskaskia River, Ill. To exercise supervision over the construction of bridges across the Mississippi River at St. Louis, Mo., and at Alton, Ill.
Milton B. Adams	In charge of the defensive works at Fort Montgomery, N. Y. In charge of the improvement of the harbors at Ogdensburg and Plattsburg, N. Y., and Burlington, Vt., and construction of breakwaters at Rouses Point, N. Y., and Gordons Landing, Lake Champlain, Vt. In charge of the improvement of St. Lawrence, Ticonderoga, Grass, and Great Chazy rivers; of narrows at Lake Champlain, N. Y., and of Otter Creek, Vt. In charge of survey of shoal in St. Lawrence River, NNW. of Haskells Shoal.
Wm. R. Livermore	In charge of the defensive works of forts at Clarks Point, Mass., Dutch Island, and Fort Adams, R. I. In charge of the improvement of the harbors of Nantucket, Woods Holl, Wareham, Hyannis, New Bedford, Vineyard Haven, Marthas Vineyard inner harbor at Edgartown, and Westport and East and West Branch of Westport River, Mass., Newport, Block Island, and Greenwich Bay, R. I., and Stonington, Conn., cove near Coasters Harbor Island, and water way between said island and Rhode Island, and construction of harbor of refuge at or near Point Judith. In charge of the improvement of the rivers Taunton, Mass., Pawtucket, Providence, Warren, and Pawcatuck, and Narragansett Bay, R. I., and removal of Green Jacket Shoal, Providence River, R. I. In charge of survey of Canapitsit Channel between Cuttyhunk and Neshawana islands, and Menemsha Bite, Mass. In charge of removal of wrecks of schooners *Benjamin Gartside*, *Josiah Whitehouse*, and *Allie Oaks* in Hyannis Harbor; *Andrew J. York* in Nantucket Sound; *Edith T. Gandy* on Nantucket Shoals; *Python* on Pollock Rip Shoal; *Florence Nowell* near Pollock Rip Light-ship, and *Mary E.*

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
MAJORS. (continued.)	
Wm. R. Livermore......	*Oliver* in Vineyard Haven Sound, Mass. In charge of construction of draw protection at the bridge across Taunton River, Somerset, Mass. To supervise the construction of bridge at Osterville, Mass. Member of Board of Engineer Officers to consider and report upon the subject of the harbor lines of the Port of Boston. Detached; engineer first and second Light-house districts.
William H. Heuer......	In charge of improvement of Humboldt Harbor and Bay, Cal. In charge of the improvement of the Sacramento, Feather, San Joaquin, and Mokelumne rivers, and Petaluma Creek, Cal. In charge of removal of wreck of barge *Philip* in San Joaquin River, below Stockton, Cal. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines of San Francisco and San Diego harbors and adjacent waters, and at San Pedro, Cal. Member of Board of Officers for the examination for promotion of certain officers of the Corps of Engineers. Engineer twelfth Light-house district.
William S. Stanton.....	Detached; Engineer first and second light-house districts. In charge of the defensive works at Forts Macon and Caswell, N. C. In charge of the improvement of Beaufort Harbor, N. C., and Georgetown Harbor, S. C. In charge of the improvement of Staunton River, Va.; Cape Fear River above and below Wilmington, Roanoke, Neuse, Pamlico, Tar, Yadkin, Black, Trent, New, North East (Cape Fear), Lockwoods Folly, and Pasquotank rivers, Contentnia, Mackeys, and Fishing creeks, Ocracoke Inlet, and inland water way from Newbern to Beaufort, inland water way between Beaufort Harbor and New River, and water way between New River and Swansboro, N. C., and Winyaw Bay, S. C. To exercise supervision over the construction of bridge across the Cape Fear River at Fayetteville, N. C.
Thomas H. Handbury ..	In charge of the defensive works at Forts Stevens, Oregon, and Canby, Wash. In charge of the improvement of the canal at the Cascades, Oregon, mouth of the Columbia River, the Lower Columbia River, Oregon, and Wash., Willamette River above Portland, and Lower Willamette River below Portland, and Youngs and Klaskuine rivers, Oregon, and of the Cowlitz River, Wash. In charge of survey of Willamette River at Clackamas Rapids, Ross Island, and Corvallis, Lower Willamette and Columbia rivers, Yamhill River from mouth to McMinnville, and Lewis and Clarks River, Oregon, Columbia River from mouth of Willamette to Vancouver, and Grays River, for snagging, Wash. In charge of water gauges on the Columbia River from Astoria to the bar. In charge of removal of wreck of the *Sylvia de Grasse* from the channel of the Columbia River, Oregon. To supervise the construction of bridges across the Willamette River opposite Albany; across the Yamhill River near Lafayette; across the Walluski River, Clatsop County, Oregon; across the Columbia River near Vancouver, and across the Cowlitz River at Toledo, Wash. Member of Boards of Engineer Officers to consider and report on the subject of the harbor lines at Portland; on ship canal to connect lakes Union, Washington, and Samamish with Puget Sound; to consider and report on the subject of the harbor lines at Olympia, Vancouver, and Bellingham Bay; and at Port Townsend, Port Angeles, Anacortes,

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
MAJORS. (continued.)	
Thomas H. Handbury...	Aberdeen, Ocosta, Ballard, Seattle, Edmonds, Sidney, Hoquiam, South Bend, Tacoma, Steilacoom, Blaine, Cosmopolis, Ilwaco, and La Conner, Wash.; and to examine and report upon the plans of two bridges over the Willamette River, and within the corporate limits of Portland, Oregon. Engineer thirteenth light-house district.
James C. Post..........	Detached; Military attaché to the United States legation at London. Delegate to the International Geographical Congress at Berne, Switzerland, August 10–15, 1891.
James F. Gregory......	Detached; Engineer Secretary of the Light-house Board. In charge of the improvement of the harbors at Manistique and Cedar River, Mich.; Menomonee, Oconto, Pensaukee, Green Bay, Ahnapee, Kewaunee, Two Rivers, Manitowoc, Sheboygan, Port Washington, Milwaukee, Racine, and Kenosha, Wis., and Waukegan, Ill. In charge of harbors of refuge at Milwaukee Bay, and at entrance to Sturgeon Bay Canal, Lake Michigan, Wis. In charge of Portage Lake and Lake Superior ship canals. In charge of the improvement of Menomonee River, Mich. and Wis., south outlet of Lake Winnebago, and removing sand bar at outlet of Fond du Lac River, and of the Fox River, Wis. In charge of water-level observations on Lake Michigan. To supervise the construction of bridges across the Sheboygan River at Sheboygan; across the Portage Canal near Portage City; across Fox River at Oshkosh; across Manitowoc River at Manitowoc, and across Wolf River at New London, Wis.
Henry M. Adams.......	In charge of the Third Division, Office of the Chief of Engineers.
Chas. E. L. B. Davis...	In charge of the improvement of the harbors at Manistique and Cedar River, Mich.; Menomonee, Oconto, Pensaukee, Green Bay, Ahnapee, Kewaunee, Two Rivers, Manitowoc, Sheboygan, Port Washington, Milwaukee, Racine, and Kenosha, Wis., and Waukegan, Ill. In charge of harbors of refuge at Milwaukee Bay, and at entrance to Sturgeon Bay Canal, Lake Michigan, Wis. In charge of Portage Lake and Lake Superior ship canals. In charge of the improvement of Menomonee River, Mich. and Wis., south outlet of Lake Winnebago, and removing sand-bar at outlet of Fond du Lac River, and of the rivers Fox and Wisconsin, Wis. In charge of water-level observations on Lake Michigan. To supervise the construction of bridge across the Sheboygan River at Sheboygan, Wis. Member of Board of Engineer Officers to investigate and report upon the alleged obstruction of navigation by a bridge over the Chicago River at Chicago, Ill. In charge of the defensive works at Forts Foote and Washington, Md.; Wool and Monroe, Va. In charge of the improvement of the Potomac River in the vicinity of Washington, and of channel in the Eastern Branch, Potomac River. In charge of the improvement of Patuxent River, Md., of the rivers Rappahannock, Mattaponi, York, and Pamunkey, and of Nomini, Urbana, Occoquan, and Aquia creeks, Va. In charge of the construction of the sewerage system at Fort Monroe, Va. To supervise the reconstruction of the Washington shore end of the "Long Bridge" at Washington, D. C.; the construction of bridge across Potomac River at "The Three Sisters," D. C.; of bridge across Patuxent River at Mt. Calvert, Md.; and of a street railway and a bridge across Mill Creek, at Fort Monroe, Va. Member of Board of Engi-

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
MAJORS. (continued.)	
Chas. E. L. B. Davis	neer Officers to consider and report upon the subject of the harbor lines in the Anacostia River, from its mouth to Bennings Bridge. Member of general court-martial convened at Cleveland, Ohio, February 3, 1892.
James B. Quinn	In charge of the defensive works at Forts Jackson, St. Philip, Livingston, Pike, and Macomb, Tower Dupré, Battery Bienvenue, and Tower at Proctorsville, La. In charge of the improvement of the Amite River and Bayou Manchac, Tickfaw, Tchefuncte, and Bogue Falia rivers, mouth and passes of Calcasieu River, bayous Terrebonne and Courtableau, and Bayou Teche from mouth to St. Martinsville, La., harbor at Sabine Pass, Blue Buck Bar, and Neches River, Tex., and Sabine River, La. and Tex., Bayou Plaquemine, for securing a navigable channel up to Plaquemine Dike, and of Bayou La Fourche, La. In charge of survey of Mermentau River, including its tributaries and course through Lake Arthur and Grand Lake to the Gulf of Mexico, La., and examination of Bayou Carlin, La., and Sabine River, Tex. In charge of removal of wreck of bark *Bruce* in the harbor of Ship Island, Miss., and of wreck of a coal barge in Bayou Teche, near Franklin, La. To report upon the depth and width of a channel secured and maintained by jetties at the mouth of the Mississippi River. Member of Board of Engineer Officers to consider and report upon a project for a lock at the mouth of Bayou Plaquemine, La. Engineer seventh and eighth light-house districts.
Daniel W. Lockwood	In charge of the improvement of Little Kanawha, Guyandotte, and Buckhannon rivers, W. Va., Big Sandy River, and Tug Fork of Big Sandy River, W. Va. and Ky.; of the Kentucky, Tradewater, Green, and Barren rivers; Levisa Fork of Big Sandy River, and Rough River from mouth to Hartford, and of Licking river from Farmers to West Liberty, Ky. In charge of examination of Green River above the mouth of Big Barren River, Ky. and Tenn. To exercise supervision over the construction of the proposed road of the Carrollton, or Lock No. 1, Turnpike Company, through the land of the United States at Lock No. 1, Kentucky River; of bridge across the Kentucky River near the mouth of Tates Creek, and of two bridges across the Tug Fork of the Big Sandy River above Catlettsburg, Ky. In temporary charge of the improvement of the Ohio River, Monongahela and Cheat rivers, W. Va., Allegheny River, Pa., and of the Muskingum River, Ohio. In temporary charge of the construction of harbor of refuge at mouth of Muskingum River; of a dam at Herrs Island, and of a movable dam at or below the mouth of Beaver River, Pa. In temporary charge of operating snag-boats on the Ohio River. To exercise supervision, temporarily, over the construction of bridges across Ohio River near Ceredo, W. Va.; over Muskingum River at Zanesville; above the mouth of Brush Creek, Ohio; over the Allegheny River at Pittsburg; over the Monongahela River at Pittsburg; near Pittsburg; and over Youghiogheny River at McKeesport, Pa. Member of Boards of Engineer Officers to consider and report upon the subject of harbor lines at Pittsburg, Pa., and on the Ohio to Davis Island Dam; on both sides of the Ohio River from the

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
MAJORS. (continued.)	
Daniel W. Lockwood	upper end of Martins Ferry to the lower end of the city of Bellaire, Ohio; and at Cincinnati, including the Licking River between its mouth and the bridge of the Louisville and Nashville Railroad; the dam to be built in the Big Sandy River near Louisa, Ky.; and upon plans of a bridge across the Ohio River between Covington, Ky., and Cincinnati, Ohio.
Ernest H. Ruffner	In charge of the improvement of the Mississippi River between Des Moines Rapids and the mouth of the Illinois River. In charge of the improvement of the harbors at Erie, Pa., and Buffalo, Wilson, Olcott, Oak Orchard, and Dunkirk, N. Y. In charge of improvement of Tonawanda Harbor and Niagara River, N. Y. In charge of measurement of the discharge of Niagara River. Member of Board of Engineer Officers to consider and report upon the subject of harbor lines at Oswego, N. Y.
John C. Mallery	Detached; Engineer fifth and sixth light-house districts. In charge of the defensive works at Forts Marion and Taylor, Fla. In charge of the improvement of the harbors at Key West, including entrance thereto, Tampa Bay, Cedar Keys, and St. Augustine, Fla. In charge of the improvement of the St. Johns River, Volusia Bar, Caloosahatchee, Manatee, Withlacoochee, Suwanee, and Pease rivers, channel of Charlotte Harbor and Pease Creek, Ocklawaha River, and Sarasota Bay, Fla.
CAPTAINS.	
Clinton B. Sears	Commanding Company A, Battalion of Engineers. Instructor in submarine mining at the U. S. Engineer School. Member of general court martial convened at Willets Point November 11, 1891.
Thomas Turtle	In charge of the fourth and fifth divisions, Office of the Chief of Engineers. Disbursing officer, Office of the Chief of Engineers. In charge of the defensive works at Forts Foote and Washington, Md., Wool and Monroe, Va. In charge of the improvement of the Potomac River in the vicinity of Washington, and of channel in the Eastern Branch, Potomac River. In charge of the improvement of Patuxent River, Md.; of the rivers Rappahannock, Mattaponi, York, and Pamunkey, and of Nomini, Urbana, Occoquan, and Aquia creeks, Va. In charge of the construction of the sewerage system at Fort Monroe, Va. To supervise the reconstruction of the Washington shore end of the Long Bridge at Washington, D. C., and the construction of a street railway, and a bridge across Mill Creek, at Fort Monroe, Va. Member of the Board of Engineer Officers to consider and report upon the subject of the dam to be built in the Big Sandy River near Louisa, Ky. Member of the United States Board on Geographic names. Member of Board of Officers to consider the matter of bonds given by disbursing officers, contractors, and others, and to prepare suitable regulations and requirements for the acceptance of bonds that may be offered by surety companies.
Edward Maguire	Detached; Engineer fourth light-house district.
Frederick A. Mahan	Detached; Engineer fourth light-house district; Engineer-secretary of the Light-House Board, temporarily. Detached; Engineer-secretary of the Light-House Board.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
CAPTAINS. (continued.)	
Charles F. Powell	In charge of the improvement of Missouri River from the Great Falls to Sioux City. In charge of the improvement of the Yellowstone River, Mont. and N. Dak. In charge of survey of Missouri River between Sioux City and Fort Benton; and between Great Falls and canyon next below Stubbs Ferry, Mont.; and from the Big Sioux River to the north line of the State of South Dakota.
John G. D. Knight	In charge of the first and second divisions, Office of the Chief of Engineers; Member of Board of Officers to test range and position finders.
Richard L. Hoxie	Commanding Company B, Battalion of Engineers; instructor in military engineering at the U. S. Engineer School; member of general courts-martial convened at Willets Point June 8, 1891, and March 24, 1892.
William L. Marshall	In charge of the improvement of the harbors at Chicago and Calumet, Ill. In charge of the improvement of the Illinois and Calumet rivers. In charge of the construction of the Illinois and Mississippi Canal. In charge of the survey of the Illinois River from Lasalle to the Mississippi River; to supervise the construction of bridge across the Illinois River at Kampsville or Columbiana, Ill., and of bridge across the Chicago River in West Chicago, Ill.; Member of Board of Engineer Officers to investigate and report upon the alleged obstructions of navigation by a bridge over the Chicago River at Chicago, Ill.; and to consider and report upon the location of the western terminus of the Illinois and Mississippi Canal; Member of Board of Officers on World's Columbian Exposition; Engineer officer, Department of the Missouri.
Joseph H. Willard	In charge of the improvement of Tensas River and Bayou Macon, La., Ouachita and Black rivers and Bayou Bartholomew in La. and Ark., Bœuf River, bayous D'Arbonne, Rondeway, and Vidal, La.; Cypress Bayou, La. and Tex.; Red River, La. and Ark., Red River above the Atchafalaya River, Ouachita River above Camden, Ark.; North Fork and main river of the Forked Deer River, South Forked Deer River, and the Big Hatchie River, Tenn.; of the rivers Big Sunflower, Yazoo, Big Black, and Tallahatchie, Tchula Lake, and Steeles and Washington bayous, Miss. In charge of survey of Yazoo River, Miss., Red River from Fulton, Ark., to the Atchafalaya River, La., and Cypress Bayou, and the lakes between Jefferson, Tex., and Shreveport, La. In charge of the water gauges on the Lower Mississippi River and its principal tributaries. To supervise the construction of the bridges across the Tensas River at Claytons Plantation; across Little River; across Bœuf River near Rayville; across Red River at Upper Falls near Alexandria; across Ouachita River near Columbia, La., and of bridge across Big Black River at Baldwins Ferry; and to supervise changes and alterations in the bridge across Big Black River at Allens Station, Miss.
Philip M. Price	In charge of the defensive works at Forts McRee, Pickens, and Barrancas, Fla. In charge of the improvement of Pensacola and Apalachicola harbors, Fla. In charge of the improvement of the rivers Coosa and Chattahoochee, Ga. and Ala., Flint, Ga., Choctawhatchee, Escambia, and Conecuh, Fla. and Ala., Alabama, Cahaba, and Tallapoosa, Ala., Apalachicola River and La Grange Bayou—improving Holmes River, Fla. To supervise the con-

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
CAPTAINS. (continued.)	
Philip M. Price.........	struction of bridge across the Alabama River near Montgomery, Ala. Member of Board of Engineer Officers on improvement of Pensacola Harbor, Fla.
Carl F. Palfrey.........	Secretary and disbursing officer of the Mississippi River Commission created by act of Congress approved June 28, 1879. Secretary and assistant to the construction committee of the Mississippi River Commission and disbursing officer for works carried on by the Commission.
William H. Bixby	In charge of the defensive works at Forts Macon and Caswell, N. C. In charge of the improvement of Beaufort Harbor, N. C., and Georgetown Harbor, S. C. In charge of the improvement of Staunton River, Va.; Cape Fear River above and below Wilmington, Roanoke, Neuse, Pamlico, Tar, Yadkin, Black, Trent, New, North East (Cape Fear), Lockwoods Folly, and Pasquotank rivers, Contentnia, Mackeys, and Fishing creeks, Ocracoke Inlet, and inland water way from Newbern to Beaufort, inland water way between Beaufort Harbor and New River, and water way between New River and Swansboro, N. C., and Winyaw Bay, S. C. In charge of removal of wreck of a schooner in Pamlico River, N. C. To exercise supervision over the construction of bridge across the Cape Fear River at Fayetteville, N. C. Member of Commission of Engineer Officers on national harbor of refuge near the mouth of Delaware Bay. In charge of the defensive works of forts at Clarks Point, Mass., Dutch Island, and Fort Adams, R. I. In charge of the improvement of the harbors of Nantucket, Wareham, Hyannis, New Bedford, Vineyard Haven, Marthas Vineyard, inner harbor at Edgartown, and Westport and East and West Branch of Westport River, Mass.; Newport, Block Island, and Greenwich Bay, R. I., and Stonington, Conn.; cove near Coasters Harbor Island, and water way between said island and Rhode Island, and construction of harbor of refuge at or near Point Judith. In charge of the improvement of the rivers Taunton, Mass.; Pawtucket, Providence, and Pawcatuck, and Narragansett Bay, R. I., and removal of Green Jacket Shoal, Providence River, R. I. In charge of removal of wrecks of schooners *Allie Oaks*, in Hyannis Harbor; *Andrew J. York*, in Nantucket Sound; *Edith T. Gandy*, on Nantucket Shoals; *Python*, on Pollock Rip Shoal; *Florence Nowell*, near Pollock Rip Light-Ship; *Mary E. Oliver*, in Vineyard Haven Sound; *Bertha J. Fellows* and *J. B. Woodbury*, Chatham Bay, Cape Cod, and part of wreck of schooner *Lucy Jones*, near Cross Rip Light-Ship, Mass. To supervise the construction of bridge at Osterville, and of bridge across Cohasset Narrows between Wareham and Bourne, Mass.
Henry S. Taber.........	In charge of the improvement of the Arkansas River—removal of snags, etc.; Arkansas River, from Wichita, Kans., to mouth, and of rivers White, St. Francis, Little Red, and Petit Jean, Ark., Black, Mo. and Ark., Little River and St. Francis River, Mo.; and of removal of rock shoals in Fourche River, Ark. In charge of survey of Clarendon and Lower White River, and examination of Red River at railroad bridge, Fulton, Ark. To supervise the construction of bridges across the Poteau River, in the Choctaw Nation, near Fort Smith; across the Arkansas River, in the Indian Territory; at Cummings Landing, at Rob Roy, and at Dardanelle, Ark.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
CAPTAINS. (continued.)	
Eric Bergland	Commanding Company C, Battalion of Engineers. Instructor in civil engineering at the U. S. Engineer School. Detached; Engineer fifth and sixth light-house districts.
William T. Rossell	Detached; assistant to the Engineer Commissioner of the District of Columbia. Detached; Engineer Commissioner of the District of Columbia.
Thomas W. Symons	In charge of the improvement of harbor at Tillamook Bay, harbor at Yaquina Bay, entrance to harbor at Coos Bay, entrance to harbor at Nehalem Bay, mouth of Siuslaw River, and of Umpqua and Coquille rivers, Oregon; the Upper Columbia and Snake rivers, Oregon and Wash., the Columbia River from the head of Rock Island Rapids to the foot of Priest Rapids, and of the rivers Chehalis, Skagit, Stielaquamish, Nootsack, Snohomish, and Snoqualmie, Wash. In charge of survey of the Columbia River from the international boundary to Rock Island Rapids, Tillamook Bay and Bar, Coquille River from Coquille City to Myrtle Point, Oregon, Olympia Harbor, and Swinomish Slough, Wash. In charge of the removal of wreck of bark *Charles Devens* in Coos Bay, Oregon. To supervise the construction of bridges across Coal Bank Slough, Oregon; across Johns River near Grays Harbor, across Chehalis River (two), across D'Wamish River (two), across Snohomish River (three), across Ebey Slough, across Swinomish Slough, across Algers Slough, Wash., and across Clearwater River above Lewiston, Idaho. Member of Boards of Engineer Officers to consider and report on the subject of the harbor lines at Portland; on ship canal to connect Lakes Union, Washington, and Samamish with Puget Sound; to examine and report upon the plans of two bridges over the Willamette River, and within the corporate limits of Portland, Oregon; to consider and report on the subject of the harbor lines at Olympia, Vancouver, and Bellingham Bay; and at Port Townsend, Port Angeles, Anacortes, Aberdeen, Ocosta, Ballard, Seattle, Edmonds, Sidney, Hoquiam, South Bend, Tacoma, Steilacoom, Blaine, Cosmopolis, Ilwaco, and La Conner, Wash.
Smith S. Leach	On duty under the immediate orders of Lieut. Col. Mansfield upon the fortifications of Boston Harbor.
Dan C. Kingman	In charge of the defensive works at Forts Niagara, Porter, and Ontario, N. Y. In charge of the improvement of the harbors at Charlotte, Great Sodus Bay, Little Sodus Bay, Oswego, Sacketts Harbor, and Pultneyville, N. Y. In charge of water-level observations on Lake Ontario. Member of Board of Engineer Officers to consider and report upon the subject of harbor lines at Oswego, N. Y.
William M. Black	In charge of the defensive works at Forts Marion and Taylor, Fla. In charge of the improvement of the harbors at Key West, including entrance thereto, Tampa Bay, Cedar Keys, and St. Augustine, Fla. In charge of the improvement of the St. Johns River, Volusia Bar, Caloosahatchee, Manatee, Withlacoochee, Suwanee, and Pease rivers, channel of Charlotte Harbor and Pease Creek, Ocklawaha River, and Sarasota Bay, Fla. Member of Board of Engineer Officers on improvement of Pensacola Harbor, Fla. Commanding Company C, Battalion of Engineers. Instructor in civil engineering at the U. S. Engineer School. Member of general court-martial convened at Willets Point, March 24, 1892.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
CAPTAINS. (continued.)	
Walter L. Fisk	In charge of the improvement of the harbors of Duluth, Grand Marais, Agate Bay, Minn.; Superior Bay on Lake Superior, St. Louis Bay, and Ashland, Wis.; Ontonagon, Eagle Harbor, and Marquette, harbor of refuge at Grand Marais, Mich., and of Minnesota Point at Superior, Wis. In charge of survey of St. Louis River, Minn., and resurvey of Marquette Harbor, Mich. In charge of water-level observations on Lake Superior. In charge of the establishment of reference marks for harbor lines in Portage Lake, Mich. To exercise supervision over construction of two bridges across the St. Louis River between the States of Minnesota and Wisconsin.
Solomon W. Roessler	In charge of first district of the Mississippi River from Cairo to foot of Island No. 40, and of second district from foot of Island No. 40 to mouth of White River, for the purpose of improvement and the construction and repair of levees. To exercise supervision over construction of bridge across the Mississippi River at Memphis, Tenn. Member of Board of Engineer Officers on building and repair of levees on the Mississippi River.
George McC. Derby	Detached; on duty at the Military Academy as instructor in practical military engineering, and in command of Company E, Battalion of Engineers. In charge of the preservation and repairs of Fort Clinton and the batteries at the Military Academy. In charge of waterworks and supply line, officer in charge of post school for enlisted men, recruiting officer for Company E, Battalion of Engineers, and acting signal officer at West Point, N. Y. In charge of the construction of a new gymnasium at West Point, N. Y. Member of board to make certain inventories concerning a gymnasium building at the United States Military Academy. Member of general courts-martial convened at West Point, N. Y., July 2, 1891, and April 5, 1892.
James L. Lusk	Detached; assistant to the Engineer Commissioner of the District of Columbia.
Frederic V. Abbot	In charge of the defensive works at Forts Moultrie, Sumter, and Johnson, and Castle Pinckney, S. C. In charge of the improvement of the harbor at Charleston, S. C. In charge of the improvement of Lumber River, and of Waccamaw River to Waccamaw Lake, N. C. and S. C.; of the Ashley, Edisto, Salkiehatchie, Little Peedee, Great Peedee, Santee, Wateree, Congaree, Clark and Beaufort rivers, Mingo Creek, and Wappoo Cut, S. C.
Thomas L. Casey	In charge of the improvement of Keyport Harbor, N. J., and harbor at Canarsie Bay, N. Y. In charge of the improvement of Arthur Kill between Staten Island and the New Jersey shore, N. Y. and N. J. In charge of the improvement of the rivers Shrewsbury, Rahway, Elizabeth, South, Raritan, and Passaic, mouth of Squan River, Shoal Harbor, and Comptons Creek, and Mattawan Creek, N. J.; Sheepshead Bay, and Sumpawanus Inlet, N. Y.; and channel between Staten Island and New Jersey. In charge of survey of Hackensack River, from below the Newark and New York Railroad Bridge, on Newark Bay, to the town of Hackensack, N. J. To supervise the use of the United States dike on Newark Bay front; the construction of bridge across Newark Bay at Newark, and of bridge across Shrewsbury River at Highland Beach, N. J. Member of Boards of Engineer

***Statement showing rank and duties of officers of Corps of Engineers*—Cont'd.**

RANK AND NAME.	DUTIES.
CAPTAINS. (continued.)	
Thomas L. Casey	Officers to consider and report upon the subject of the harbor lines in Stamford Harbor; at Norwalk, and at Bridgeport, Conn.
Theodore A. Bingham	Detached; military attaché to the United States legation at Berlin.
Curtis McD. Townsend	In charge of third district of the Mississippi River, from mouth of White River to Warrenton, for the purpose of improvement and the construction and repair of levees, to include the improvement of the harbor at Vicksburg, Miss. Member of Board of Engineer Officers on building and repair of levees on the Mississippi River.
Gustav J. Fiebeger	In charge of the improvement of the harbor at Norfolk, and the approach to Norfolk Harbor and the United States Navy Yard, Va. In charge of the improvement of the Appomattox, Chickahominy, and Nansemond rivers, including mouths of Bennett and Chuckatuck creeks, and of Hampton Creek and Bar, Va., North Landing River, and inland water route from Norfolk Harbor, Va., to Albemarle Sound, N. C., through Currituck Sound, Va. and N. C., Currituck Sound, Coanjok Bay and North River Bar, N. C. Member of Board of Engineer Officers to consider and report upon the subject of harbor lines in James River from Richmond to City Point, Va. Detached; Assistant to the Engineer Commissioner of the District of Columbia.
Oberlin M. Carter	In charge of the defensive works at Forts Oglethorpe and Pulaski, Ga., and Clinch, Fla. In charge of the improvement of the harbors at Savannah, Brunswick, and Darien, Ga. In charge of the improvement of Cumberland Sound, Ga. and Fla., Savannah, Altamaha, Ocmulgee, and Oconee rivers, and Jekyl Creek, Ga. In charge of survey of Brunswick Outer Bar, and inside routes between Doboy and Sopelo, Ga., and between Savannah, Ga., and Fernandina, Fla. In charge of removal of wrecks of steam flat *Molton*, in Darien River, near Darien, and of steamboat near mouth of Three-Mile Cut, and of sailing vessel in Savannah Harbor, Ga. To exercise supervision over the construction of two bridges across the Oconee River at or near Dublin, of bridge at Dublin, and of bridge across Savannah River at or near "Sisters Ferry," Ga. Member of Board of Engineer Officers on improvement of Pensacola Harbor, Fla.
George W. Goethals	In charge of the improvement of Tennessee River from Chattanooga to the foot of Bee Tree Shoals. To supervise the construction of bridge across Elk River at Elk River Mills, Ala.
FIRST LIEUTENANTS.	
John Millis	In charge of fourth district of the Mississippi River from Warrenton to head of the passes, for the purpose of improvement and the construction and repair of levees, to include levees and special work on the river, the improvement of the harbor at New Orleans, the Mississippi River at Natchez and Vidalia, the mouth of Red River, and at the mouth of Bayou Plaquemine, and the rectification of the Red and Atchafalaya rivers at mouth of Red River; member of Board of Engineer Officers on building and repair of levees on the Mississippi River.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
FIRST LIEUTENANTS. (continued.)	
John Biddle	On duty under the immediate orders of Lieutenant-Colonel Barlow. On duty under the immediate orders of Lieut. Col. Robert.
Harry F. Hodges	Detached; on duty at the Military Academy as Assistant Professor of Civil and Military Engineering; member of Board to make certain inventories concerning a gymnasium building at the United States Military Academy; member of general courts-martial convened at West Point, N. Y., July 2 and December 22, 1891, and April 5, 1892.
James G. Warren	Adjutant and Treasurer of the Battalion of Engineers and Post of Willets Point, and Signal Officer and Recruiting Officer, Post of Willets Point. Commanding Company D, Battalion of Engineers. Inspector of small-arms practice, Battalion of Engineers. In charge of property pertaining to the library of the U. S. Engineer School. On duty under the immediate orders of Lieut. Col. Gillespie.
Edward Burr	On duty under the immediate orders of Maj. Handbury. In charge of the improvement of the harbor at Norfolk, and the approach to Norfolk Harbor and the United States Navy Yard, Va. In charge of the improvement of the Appomattox, Chickahominy, and Nansemond rivers, including mouths of Bennett and Chuckatuck creeks, and of Hampton Creek and Bar, Va., North Landing River, and inland water route from Norfolk Harbor, Va., to Albemarle Sound, N. C.
Lansing H. Beach	Detached; on duty at the Military Academy in Department of Civil and Military Engineering. In charge of supervision of construction of Battle Monument at West Point, N. Y. Judge Advocate of general court-martial convened at West Point, N. Y., December 22, 1891.
Graham D. Fitch	On duty under the immediate orders of Capt. Symons.
George A. Zinn	On duty under the immediate orders of Lieut. Col. Hains. On duty under the immediate orders of Maj. Overman. On duty under the immediate orders of Capt. Turtle. On duty under the immediate orders of Maj. Davis.
William C. Langfitt	On duty under the immediate orders of Maj. Allen.
Henry E. Waterman	On duty under the immediate orders of Maj. Davis. On duty under the immediate orders of Maj. Gregory.
James C. Sanford	Secretary and disbursing officer of the Missouri River Commission created by act of Congress approved July 5, 1884.
Hiram M. Chittenden	On duty under the immediate orders of Maj. Jones.
Cassius E. Gillette	On duty under the immediate orders of Lieut. Col. Merrill. On duty under the immediate orders of Maj. Lockwood. On duty under the immediate orders of Maj. Stickney. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines at Pittsburg, Pa., and on the Ohio to Davis Island Dam; on both sides of the Ohio River from the upper end of Martins Ferry to the lower end of the city of Bellaire, Ohio; and at Cincinnati, including the Licking River between its mouth and the bridge of the Louisville and Nashville Railroad; and upon plans of a bridge across Ohio River between Covington, Ky., and Cincinnati, Ohio. Detached; Engineer Officer Department of the Missouri.
David DuB. Gaillard	On duty under the immediate orders of Capt. Black. Detached; member of International Boundary Commission for the location and marking of the boundary between the United States and Mexico, under the direction of the Secretary of State.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
FIRST LIEUTENANTS. (continued.)	
Harry Taylor	On duty under the immediate orders of Lieut. Col. Gillespie. On duty under the immediate orders of Maj. Handbury. Member of Board of Engineer Officers to examine and report upon the plans of two bridges over the Willamette River, and within the corporate limits of Portland, Oregon.
William L. Sibert	On duty under the immediate orders of Maj. Lockwood.
Joseph E. Kuhn........	Detached; on duty at the Military Academy in Department of Civil and Military Engineering. To supervise the erection of a new academic building at West Point, N. Y.
William E. Craighill ...	On duty under the immediate orders of Capt. Price.
Henry C. Newcomer	On duty under the immediate orders of Col. Mendell.
Mason M. Patrick	On duty under the immediate orders of Capt. Bixby. In temporary charge of the defensive works at Forts Macon and Caswell, N. C. In temporary charge of the improvement of Beaufort Harbor, N. C., and Georgetown Harbor, S. C. In temporary charge of the improvement of Staunton River, Va.; Cape Fear River above and below Wilmington, Roanoke, Neuse, Pamlico, Tar, Yadkin, Black, Trent, New, North East (Cape Fear), Lockwoods Folly, and Pasquotank rivers, Contentnia, Mackeys, and Fishing creeks, Ocracoke Inlet, and inland water way from New Berne to Beaufort, inland water way between Beaufort Harbor and New River, and water way between New River and Swansboro, N. C., and Winyaw Bay, S. C. To exercise supervision temporarily over the construction of bridge across the Cape Fear River at Fayetteville, S. C. On duty under the immediate orders of Maj. Stanton. Detached; on duty at the Military Academy as assistant instructor in practical military engineering, and with Company E, Battalion of Engineers. Recruiting officer for Company E, Battalion of Engineers. In charge of post school for soldiers' children at West Point, N. Y. Member of general court-martial convened at West Point, N. Y., May 23, 1892.
Charles S. Riché........	On duty under the immediate orders of Col. Poe. Member of Board of Engineer Officers to consider and report upon the subject of harbor lines at Detroit, Mich.
Thomas H. Rees	On duty under the immediate orders of Capt. Carter.
Charles L. Potter.......	On duty under the immediate orders of Col. Mendell. On duty under the immediate orders of Lieut. Col. Benyaurd.
Francis R. Shunk	On duty with Company B, Battalion of Engineers. Member of Electrical Board for the District of Columbia. Assistant instructor in civil engineering at the U. S. Engineer School. Judge-advocate of general court-martial convened at Willets Point November 11, 1891. On duty under the immediate orders of Capt. Symons.
Eugene W. VanC. Lucas.	Detached; on duty at the Military Academy as Assistant Instructor in Practical Military Engineering, and with Company E, Battalion of Engineers. Recruiting Officer for Company E, Battalion of Engineers. In temporary command of Company E, Battalion of Engineers. In temporary charge of water works and supply line, and of Post School for enlisted men at West Point, N. Y. Member of general court-martial convened at West Point, N. Y., July 24, 1891. On duty under the immediate orders of Maj. Stanton.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
FIRST LIEUTENANTS. (continued.)	
Henry Jervey	Q. M. Battalion of Engineers. A. A. Q. M., and A. C. S., Post of Willets Point. Instructor in Military Photography at the U. S. Engineer School. Inspector of small-arms practice, Battalion of Engineers.
SECOND LIEUTENANTS.	
James J. Meyler	On duty under the immediate orders of Lieut. Col. Benyaurd.
Charles H. McKinstry	Detached; on duty with Company E, Battalion of Engineers, at the Military Academy. Member of general courts-martial convened at West Point, N. Y., July 2, 1891, and February 29, 1892.
William V. Judson	On duty under the immediate orders of Maj. Overman. In temporary charge of the improvement of harbors at Monroe, Mich.; Toledo, Port Clinton, Sandusky, Vermillion, Huron, Cleveland, Fairport, Ashtabula, and mouth of Black River, and of Sandusky River, Ohio. In temporary charge of water-level observations on Lake Erie. On duty under the immediate orders of Lieut. Col. Smith.
Eben E. Winslow	On duty with Company B, Battalion of Engineers. Officer in charge of Post Schools, Post of Willets Point, N. Y. Under instruction at the U. S. Engineer School. Member of general courts-martial convened at Willets Point June 8 and November 11, 1891. On duty under the immediate orders of Maj. Damrell.
Albert M. D'Armit	On duty with Company C, Battalion of Engineers. Librarian of the Post and U. S. Engineer School libraries at Willets Point, N. Y., and in charge of the property pertaining thereto. Under instruction at the U. S. Engineer School. Member of general court-martial convened at at Willets Point November 11, 1891. On duty under the immediate orders of Maj. Raymond.
Clement A. F. Flagler	On duty with Company A, Battalion of Engineers. Under instruction at the U. S. Engineer School. Judge-advocate of general court-martial convened at Willets Point June 8, 1891. Member of general court-martial convened at Willets Point March 24, 1892. On duty under the immediate orders of Col. Mendell.
Chester Harding	On duty with Company B, Battalion of Engineers. In charge of Post Exchange, Post of Willets Point, N. Y. Under instruction at the U. S. Engineer School. Member of general court-martial convened at Willets Point November 11, 1891. On duty under the immediate orders of Capt. Marshall.
William W. Harts	On duty with Company C, Battalion of Engineers. Under instruction at the U. S. Engineer School. Member of general courts-martial convened at Willets Point June 8, 1891, and March 24, 1892. On duty under the immediate orders of Capt. Bixby.
Robert McGregor	On duty with Company A, Battalion of Engineers. Under instruction at the U. S. Engineer School. Adjutant and Treasurer of the Battalion of Engineers. Adjutant, Signal Officer, and Recruiting Officer, Post of Willets Point. Commanding Company D, Battalion of Engineers. Member of general court-martial convened at Willets Point June 8, 1891.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
SECOND LIEUTENANTS. (continued.)	
Edgar Jadwin	On duty with Company B, Battalion of Engineers. Post Treasurer and Mess Officer, Post of Willets Point, N. Y. Under instruction at the U. S. Engineer School. Member of general courts-martial convened at Willets Point June 8, 1891, and March 24, 1892.
ADDITIONAL SECOND LIEUTENANTS.	
Charles Keller	On duty with Company C, Battalion of Engineers. Acting Ordnance Officer, Post of Willets Point, N. Y. Under instruction at the U. S. Engineer School. Member of general court-martial convened at Willets Point November 11, 1891.
Herbert Deakyne	On duty with Company A, Battalion of Engineers. Librarian of the Post and U. S. Engineer School libraries at Willets Point, N. Y., and in charge of the property pertaining thereto. Assistant to the Post Quartermaster at Willets Point, N. Y. Under instruction at the U. S. Engineer School. Member of general court-martial convened at Willets Point November 11, 1891.
Charles S. Bromwell	On duty with Company B, Battalion of Engineers. On duty with Company A, Battalion of Engineers. Under instruction at the U. S. Engineer School. Member of general court-martial convened at Willets Point November 11, 1891.
Spencer Cosby	On duty with Company B, Battalion of Engineers. In charge of Post Exchange, Post of Willets Point, N. Y. Under instruction at the U. S. Engineer School. Member of general courts-martial convened at Willets Point November 11, 1891, and March 24, 1892.
John S. Sewell	On duty with Company C, Battalion of Engineers. Officer in charge of Post Schools, Post of Willets Point, N. Y. Under instruction at the U. S. Engineer School. Member of general courts-martial convened at Willets Point November 11, 1891, and March 24, 1892.
Charles P. Echols	On duty with Company A, Battalion of Engineers. Under instruction at the U. S. Engineer School. Member of general court-martial convened at Willets Point November 11, 1891.
James F. McIndoe	On duty with Company B, Battalion of Engineers. Under instruction at the U. S. Engineer School. Member of general court-martial convened at Willets Point November 11, 1891.
Jay J. Morrow	On duty with Company C, Battalion of Engineers. On duty with Company A, Battalion of Engineers. Under instruction at the U. S. Engineer School. Member of general court-martial convened at Willets Point November 11, 1891.
U. S. AGENT.	
William F. Smith, *Major of Engineers, U. S. A., Retired.*	In charge of the improvement of the harbors at Wilmington, Del., Cambridge, Md., Onancock, and Cape Charles City and Chenton Inlet., Va., and ice-harbor at New Castle, Del. In charge of the improvement of the Broadkiln, Appoquinnimink, and Smyrna rivers, and Duck and Mispillion creeks, Del., Susquehanna River, Md. and Pa., Choptank, Wicomico, Manokin, Chester, Elk, and North East rivers, and of Fairlee Creek or Inlet, Md., and inland waterway from Chincoteague Bay, Va.,

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
U. S. AGENT. (continued.)	
William F. Smith, *Major of Engineers, U. S. A., Retired*	to Delaware Bay at or near Lewes, Del. In charge of survey of Murderkill and Mispillion rivers, Del., Rock Hall Harbor, Susquehanna River above Havre de Grace, La Trappe and Warwick rivers, and Broad and Turners creeks, Md.; and of survey to locate the canal between Rehoboth Bay and Delaware Bay—a part of the proposed waterway from Chincoteague Bay, Va., to Delaware Bay. To supervise the construction of bridges across Brandywine Creek at Wilmington, and across Christiana River in New Castle County, Del. In charge of removal of wrecks of schooners *Harvey W. Anderson* off Hog Island, and *Ann R. Rogers* off Cobbs Island, Va.
U. S. CIVIL ENGINEER.	
M. Meigs	On duty under the immediate orders of Major Mackenzie.

APPENDIXES

TO THE

REPORT OF THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

APPENDIXES

TO THE

REPORT OF THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

FORTIFICATIONS, ETC.

APPENDIX No. 1.

PROTECTION OF SITE OF FORT NIAGARA, NEW YORK.

REPORT OF CAPTAIN DAN C. KINGMAN, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., July 9, 1892.

GENERAL: I have the honor to transmit herewith annual reports for the fiscal year ending June 30, 1892, for the following works in my charge:

* * * Protection of the site of Fort Niagara, New York.

Very respectfully, your obedient servant,

DAN C. KINGMAN,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

PROTECTION OF THE SITE OF FORT NIAGARA, NEW YORK.

Operations have been in progress for the protection of the site of Fort Niagara, New York, under an allotment from the appropriations for "sea walls and embankments," and "preservation and repair of fortifications." The project for this work was approved November, 1888, and is briefly as follows:

First. To build a dike of stakes and fascines, paved on the top with stone, and held at a reference 2.0 feet, Lake Ontario gauge, from the northwest bastion of Fort Niagara to the northerly angle of the wharf, and to demolish the wall that makes the western front of the fort and use its material as a riprap and filling behind the dike.

Second. To build a similar dike from the southern end of the lighthouse reservation towards the southern end of the military reservation of Fort Niagara, as far as the means available will permit, and to fill in behind the dike, a bank of low slope to a reference 6.0 feet, Lake Ontario gauge; to grade the bank above to a slope of 1 on 2 down from the general level of the parade, leaving between the two slopes such a roadway as may be desirable for the use of the post; to plant the lower slope with willows and the upper one with grass. Subsequently this project was modified by substituting iron pipes for the wooden stakes used to secure the fascines. This change increased the durability of the work, but it also increased its cost nearly 50 per cent. The project was extended to include the repair of the retaining wall at the northwest angle of the fort, and all other necessary repairs to the same along the lake front.

The amount expended under this project to June 30, 1892, is $29,449.38, and has resulted in the rebuilding of a portion of the retaining wall 40 feet long and 39½ feet high, bonded into the old work, and in the repair of numerous breaks in the face of the wall along the lake front (over 50 cubic yards of dimension stone being used for the latter purpose alone), in a pretty general pointing of this wall, and in the construction of a concrete breakwater 70 feet long to protect the exposed northwest angle. It has also resulted in the construction of 770 feet dike work along the lake front, and 941 feet along the river front—1,711 feet in all—and in the filling in and grading behind 941 feet along the river front according to the project. Sodding the slopes is now in progress.

OPERATIONS.

The work of repairing the sea wall was resumed August 4, 1891, and continued until December 14, 1891. The coping was laid on the rebuilt angle of the wall, a large amount of grouting and pointing was done to the wall generally, and a number of very large cavities in the wall were carefully and thoroughly repaired. Some of the holes extended nearly through the backing, and the largest was about 54 feet long and 4 feet high. They were all near the mean-water line. The water was from 1 to 4 feet deep along the base of the wall, and the slightest onshore wind caused the waves to dash violently into the breaks. The bottom was very hard, and it would have been difficult and expensive to build cofferdams that would stand. I accordingly caused a strong crib to be built in the form of a scow, 20 feet long, 12 feet wide, and 6 feet high. It had a strong tight deck, and a bottom made of 4-inch oak plank. The whole was calked and pitched and made water-tight. It was intended to load it with a sufficient quantity of stone to hold it firmly on the bottom when filled with water; then to float it to the described position, open valves which were provided, and allow it to sink. Its deck would then be 2 or 3 feet above the surface of the water and would serve as a platform for the masons, while the side of the crib would protect the work from small waves which would tend to wash the mortar out of the joints before it had time to set. When it became necessary to move the crib, the valves could be closed, the water pumped out, and it could easily be floated to the new position.

The crib cost about $530 for labor and materials; but it was not needed, for the lake fell with unusual rapidity and attained an exceptionally low stage early in the season, so that by rolling up stones near the base of the wall a beach was caused to form, upon which the men could stand and work when the lake was smooth. A concrete breakwater, 70 feet long, 8 feet high, 13 feet thick at the base and 6 feet on top, with a batter towards the lake, was built to protect the northwest angle of the wall. It rested on a submerged timber crib that had been built for this purpose during the previous year. The bottom in front of this structure was covered with heavy bowlders. The stone needed for the repairs to the wall and for a belt course for the concrete breakwater was brought from the limestone quarries at Chaumont, N. Y.

The fascine breakwater had been damaged at two or three points along the lake front, and it was repaired using large bowlders from the lake.

The total cost of all this work was $6,256.35, including $530 for the movable crib. The expenditure was divided as follows:

Labor	$3,932.20
Building stone	918.88
Cement	805.70
Lumber	254.18
Other material and tools	153.10
Engineering and office expenses	192.29
Total	6,256.35

In addition, the work of grading the bank along the river front was begun October 8, 1891, and the earthwork was completed December 10, 1891. Nine hundred and forty-one feet of bank was graded. The bank was given a slope of two on one, and the fill was made behind the stake and fascine breakwater as described in the project. Fourteen thousand one hundred and ninety-nine cubic yards of earth was moved to accomplish this work. The bank was very hard in places, and explosives were tried, with indifferent success, to break it up.

The project provides for the protection of the lower flat slope next to the water by a growth of willows. As the work was finished in December it was obviously impossible to secure a growth that would afford the slightest protection during the coming spring freshets. This slope was therefore covered with a rough pavement of stone. The drains from the quarters near this work were permitted to discharge over the bank. To prevent this water from injuring the slope, open wooden drains were built to carry it to the river, till such time as the houses are connected with a proper sewer which is now in progress of construction.

The total cost of this work was $4,981.98, which was divided as follows:

Labor	$4,237.96
Stone	540.00
Lumber	47.98
Other materials	17.28
Engineering and office expenses	38.76
Total	4,981.98

Work was suspended January 18, 1892. It was resumed June 24, with the object of redressing the slopes and securing a growth of grass upon them.

REMARKS.

No other work than that of protecting the slope can be undertaken with the funds now available. The sea wall is now in good condition for work of this kind. It was never anything more than coursed rubble of rather soft stone. The bank protection might be extended up the river to good advantage.

In pursuance of the project of November, 1888, some 154 linear feet of the detached wall that forms the western front of the work was torn down and the stone used to fill in behind the dike. This was done during the first season's work. It makes a very conspicuous and unsightly breach and leaves the work entirely open and easy of entrance on this side.

There is plenty of other stone available for filling behind the dike, and I would recommend that this wall be restored. The cost would not exceed $3,000; $10,000 in addition, if that sum were available, could be advantageously applied to the continuation of the work of protecting the site during the fiscal year ending June 30, 1893.

Money statement.

July 1, 1891, balance unexpended	$11,688.95
June 30, 1892, amount expended during fiscal year	11,138.33
July 1, 1892, balance unexpended	550.62
July 1, 1892, outstanding liabilities	30.00
July 1, 1892, balance available	520.62
Amount (estimated) required for completion of existing project	26,105.30
Amount that can be profitably expended in fiscal year ending June 30, 1894.	13,000.00

APPENDIX No. 2.

SEA WALL AND EMBANKMENT AT DAVIDS ISLAND, NEW YORK HARBOR, SEA WALL AT GOVERNORS ISLAND, NEW YORK HARBOR.

REPORT OF COLONEL DAVID C. HOUSTON, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

IMPROVEMENTS.

a. Sea wall at Davids Island, New York Harbor.

b. Sea wall at Governors Island, New York Harbor.

ENGINEER OFFICE, U. S. ARMY,
New York, July 9, 1892.

GENERAL: I have the honor to transmit herewith annual reports for the fiscal year ending June 30, 1892, upon * * * sea walls at Davids and Governors islands, New York Harbor.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Colonel, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

---

2 A.

SEA WALL AND EMBANKMENT AT DAVIDS ISLAND, NEW YORK HARBOR.

This island, which is occupied by the recruiting service of the Army, lies at the head of Long Island Sound, about opposite New Rochelle, and is 21 miles distant by water from the battery, New York City.

In 1883, upon recommendation of the depot surgeon, an estimate for a sea wall was transmitted to Congress, papers concerning which were printed in House Ex. Doc. No. 205, Forty-eighth Congress, second session. The recommendation was renewed in 1884.

The object first stated was to prevent the collection of garbage and refuse matter upon the shores; the second recommendation stated, as an additional and important object, the preservation of a fresh-water pond from overflow by the sea at high tides. The pond was separated from the sound by a narrow beach which was not high enough to prevent waves breaking over. This pond, formerly used as a water supply, is now used chiefly for obtaining ice. An additional object of the sea wall is the reclamation of about 2 acres of low marshy land, which the embankment was intended to fill up.

In 1886 a revised estimate of cost was presented, as follows:

1,000 linear feet of wall, at $35 per foot	$35,000
40,000 cubic yards of earth embankment at 30 cents per cubic yard	12,000
Total	47,000

The plan then was to build the wall of masonry and carry it to 12 feet above mean low-water level. The mean rise of tide is 7.3 feet.

Under the appropriation for sea walls and embankments, made by act of Congress approved September 22, 1888, an allotment of $47,000 was made for the above work. The plan of construction of sea wall was modified to one for a riprap wall with outer slope 1 on 2, inner slope 1 on 1, to be built to 10 feet above low water and capped with a course of dimension stone 2 feet thick and 6 feet wide. The originally designed vertical masonry wall was intended to prevent the lodgment of garbage, etc., but the stringent regulations concerning the disposal of such matter now being enforced in the harbor of New York and adjacent waters will prevent any nuisances of that kind, and the riprap wall was considered equally efficient for every other purpose and more economical. The sea wall was completed in April, 1890.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

No work upon the sea wall has been done.

A survey of the island in connection with desired sea walls was made in June, 1891. The map of this survey was made and transmitted to the Chief of Engineers with final report dated May 20, 1892.

PRESENT CONDITION.

The sea wall is 954 feet long and contains 9,068 tons of riprap and 953.7 linear feet of capping stones 2 feet thick and 6 feet long, stretching across the wall; its height is 12 feet above mean low water, about 4¾ feet above mean high water. The wall is in good condition; it has settled slightly in places, owing to the softness of the foundation on which it rests, but not enough to need repair. The embankment contains 31,836 cubic yards of filling.

The embankment close to the wall has been cut out to depths of from one-half foot to 1½ feet in places by seas breaking over the wall at extremely high tides. It will require about 1,000 cubic yards of filling to repair the bank.

PROPOSED OPERATIONS.

Nothing further is contemplated except to repair the damage to the embankment above described, and such other slight repairs as may from time to time be needed.

The report on the survey referred to mentions a wall on the west side of the island, north of the coal wharf, as necessary to check the continuing erosion of the shore; the estimated cost of this wall and of embankment behind it is $30,000.

Money statement.

July 1, 1891, balance unexpended	$11,597.86
Amount transferred to allotment for sea wall, Governors Island	6,597.86
July 1, 1892, balance unexpended	5,000.00
Amount (estimated) required for completion of existing project	55,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	30,000.00

REPORT OF SURVEY OF DAVIDS ISLAND, NEW YORK HARBOR, FOR SEA WALL ON THE WEST SIDE AND AT OTHER POINTS.

ENGINEER OFFICE, U. S. ARMY,
New York, May 20, 1892.

GENERAL: I have the honor to transmit by mail to-day, in separate package, a tracing * of the survey of Davids Island, made in June, 1891, in connection with consideration of plans for sea walls at several points on the island. A preliminary report on this survey was transmitted with the Annual Report for 1891, before the map was platted. Completion of the map has been delayed until opportunity afforded to correctly locate upon it the new mortar battery, in process of construction, and the several permanent buildings on the island.

The map shows in red the positions of the sea walls mentioned in the Annual Report for 1891, for which approximate estimates of cost were submitted.

The soil of the island consists of alluvial sand and gravel, with varying proportions of clay and, in a few low places on the south and east sides, of salt marsh mud. The underlying rock (a very much metamorphosed granite, showing in close proximity a fair grade of granite, quartz veins, and soft schist) outcrops in many places at the exposed parts of the island on the north, east, and south shores, leaving bays between the ledges, where the soil is easily eroded by wave action. Outlying rocky islands and shoals to the northeast afford some natural protection to the north and east sides, and the south side is generally a high rocky bluff. The west or landward side is not exposed to heavy seas except north of the coal wharf, when the seas from northeast storms roll around the island; the northwest point of the island and about 1,000 feet of the north part of the west shore are stony—mostly bowlders with probably some low ledges—and not affected by the waves. Southward to the coal dock the shore consisted of easily eroded sand and gravel, and the waves striking this obliquely cut considerable gaps into the bank during heavy storms. Since the survey was made (June, 1891) this part of the bank has washed away from 1 to 4 feet and will presumably continue to erode until protected. The sea wall proposed for this location—the west wall—is the only one urgently needed at present. The wall should be 1,100 feet long, extending from the shore end of the coal wharf to a point in the rear of the blacksmith shop, where it should be anchored to the high ground either by prolonging it or by building a short return. The embankment behind this wall would cover and reclaim about 1½ acres of land now covered by high water.

The north side of the island is protected by several low ledges and more or less by compact shingle between high and low water marks. For a stretch of about 500 feet the available surface of the island consists of a sandy loam, rather shallow, from 1 to 4 feet deep, overlying such ledges and shingle. This soil used for gardening, though above ordinary high-water mark, is attacked somewhat by waves in unusually high tides and rough weather; the amount of erosion is not great, and none is noticeable since June, 1891. The sewage from the hospital and from the newest barracks is carried down this shore to or nearly to low water; the sewers are laid on the surface of the shore, owing to the difficulty of getting them down into the shingle and ledge, and are often broken and disarranged by storms, and during winter freeze up and are broken by drift ice. The north sea wall is desired both to protect the garden and the sewers. On both these accounts it would be a desirable addition to the Government property, but is not nearly as important as the west wall.

---

* Omitted.

On the northeast point of the island is a narrow bay inclosed between ledges, where the seas have evidently eroded the bank for some distance. There is no appearance of material erosion since June, 1891, and I am inclined to believe it will not continue much farther up the shore. A sea wall (the northeast wall) will return to high ground at this bay, would be about 300 feet long, and with embankment was estimated in the last Annual Report to cost $11,000. Its construction could properly be deferred until the other two are built.

Besides these three places, there are none other on the island where a sea wall is now needed for protection of the shore. On the west side, between the wharves, there is a beach of about 400 feet length, which is subject to slight erosion; but only such as can be prevented by an ordinary stone wall or by sheet piling. Below the landing wharf and at the southeast end of the island, sea walls may at some future time be desired either to reclaim additional land and make marshy tracts available, or for the sake of appearances. When such need becomes sufficiently evident, fairly approximate estimates of cost can be made from the map submitted herewith.

DESIGN FOR CONSTRUCTION OF SEA WALLS AND ESTIMATES OF COST.

The sea walls desired on the west side of the island, north of the coal wharf, can best be built on the general plan of the one built on the east side in 1890–'91, the cross-section being reduced, as the exposure to violent storms is less.

For these cases a riprap wall of 5 feet top width, covered by a coping of split stone 2 feet high and 4 feet wide, would undoubtedly be sufficient; the top of the coping to be 12 feet above mean low water (about 5 feet above mean high water) and the inner part of the riprap to be of small stone, to prevent wasting of the filling, the embankment to be graded back from the wall to the natural bank, with a rise of about one foot in twenty.

The wall on the west side would require about:

6,200 tons of riprap at $1.50	$9,300
1,100 linear feet of coping at $5	5,500
Contingencies, etc., about	1,200
	16,000

and the embankment behind it about:

28,000 cubic yards filling at 45 cents	12,600
Contingencies, etc., about	1,400
	14,000
Or the total cost for west wall and embankment	30,000

The wall for the north side would be about 500 feet long, and would require for construction about:

2,000 tons riprap at $1.60	$3,200
500 linear feet coping at $5	2,500
12,000 cubic yards embankment at 55 cents	6,600
Contingencies of wall and embankment, about	1,700
	14,000

The northeast wall, if pushed out as far as practicable, in order to gain the additional land, would cost, as before estimated, about $11,000. A sufficient protection to the shore could be built at a cost of about $3,000. The location shown on the map, intermediate between the two, would cost about $6,000.

At all of these points the bottom is sufficiently hard to support such a wall without sinking, except for part of the length of the west wall, about 150 feet, where it is a rather light muddy sand, and from 1 to 3 feet of sinking may be expected.

The amount now required is $30,000.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Colonel, Corps of Engineers.

Brig. Gen. THOS. L. CASEY,
Chief of Engineers, U. S. A.

---

2 B.

SEA WALLS ON GOVERNORS ISLAND, NEW YORK HARBOR.

The shores of this island were frequently covered with offal and garbage, which, drifting up at high water, and decaying in the sun as the tide fell, were (in summer) a source of constant danger to the health of the garrison.

In 1865 a project was adopted providing for inclosing the entire island by a masonry wall, to be built at or near low-water line, in order to prevent the lodging of such refuse matter.

Under an allotment made in 1865, 700 linear feet of masonry wall was built on the southwest side of the island in 1866, and under other smaller allotments 399 linear feet, as reported, was built. This would make a total of 1,099 feet, which, however, exceeds the present length by actual measurement by about 350 feet. This was subsequently extended as a temporary dry wall nearly along high-water line to Castle Williams, covering the entire southwest side of the island.

By act approved August 7, 1882, $39,000 was appropriated for "completing a sea wall already commenced on the southwest side of Governors Island, New York Harbor, and constructing a sea wall on its southeastern portion." Under this appropriation and one of $15,000 made in the sundry civil bill, approved March 3, 1883, the wall was extended 206 feet along the south side of the island and 1,502½ feet along the east side of the the coal wharves. In 1884 an allotment of $500 was made for completing the filling and grading behind the east wall, left unfinished on acount of the exhaustion of funds.

From the coal wharf to the permanent stone wharf, a distance of about 325 feet, the island is inclosed by wharf fronts and timber bulkheads. On account of the protection afforded by these structures, this portion of the island has not heretofore been included in the project for inclosing the entire island by a masonry wall. These wooden structures are decayed and rapidly deteriorating, and should be replaced by a permanent stone wall.

From the permanent stone wharf to within 1,099 feet of Castle Williams wall the island is inclosed by the Ordnance wall. Under the appropriation of September 22, 1888, $50,000 were appropriated for the construction of a wall about 1,100 feet long, on the north side of the island, between the Ordnance wall and the Castle Williams wall. This wall, 1,099 feet long, was completed April 4, 1890.

July 1, 1891, a contract for construction of a sea wall to connect the Castle Williams wall with the wall around the south side of the island was in progress under the appropriation of $50,000, "for completing sea wall on Governors Island, New York Harbor," included in the appropriation for preservation and repair of fortifications, approved August 18, 1890; 144.05 cubic yards of concrete foundation and 153.59 linear feet of masonry wall had been laid.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

Work under the contract with Breuchaud, Pennell & Co. was continued.

For part of the required embankment, a supplementary contract was entered into, which provides for using earth on the island to fill behind the sea wall at the price of 24 cents per cubic yard. During the fiscal year 510.19 cubic yards of concrete foundation and 1,345.5 linear feet of masonry wall were laid. Under the original contract, at 29 cents per cubic yard, 483 cubic yards of embankment were placed behind the north wall and 2,403 cubic yards behind the west wall, total 2,886 cubic yards, and under the supplementary contract, at 24 cents, 1,373 cubic yards were placed behind the north wall and 37,141 cubic yards behind the west wall, total 38,514 cubic yards.

The contract was completed in March, 1892; the total amount of work done under it and the supplementary contract was the laying of 659.24 cubic yards of concrete foundation and 1,499.14 linear feet of masonry wall, and the placing of 1,856 cubic yards of embankment behind the north wall and 39,544 cubic yards behind the west wall.

The amount of concrete required for the foundation was smaller than had been estimated, and a balance of the appropriation remained. After advertising by circular letter, with the approval of the Chief of Engineers, a contract was entered into with Michael Flaherty for constructing about 212 linear feet of sea wall on the east side of the island north of the east wall, to extend from that wall through and under the coal shed and the Quartermaster's Wharf to replace the old and decaying wooden bulkhead at that place. The price is $23.38 per linear foot of wall, including foundation and embankment behind the wall. The wall is to be 9.2 feet high, 3 feet wide at top, 4 feet at bottom, the outer face vertical, and resting on a concrete foundation 6 feet wide; the stone taken from the old dry wall on the west side of the island to be used in construction.

Work under this contract has not yet been begun.

PRESENT CONDITION OF THE SEA WALLS AROUND THE ENTIRE ISLAND.

For 1,023 feet west of the permanent stone wharf the island is inclosed by the Ordnance wall; 917 linear feet of this wall needs repointing, the mortar being washed out of most of the joints to a depth of from 2 to 12 inches, endangering the stone work. With this exception the Ordnance wall is in good condition.

The next 1,099 feet is covered by the sea wall on the north side of the island, completed in 1890. The wall and foundation are in good condition, but the foundation ought to be protected with about 650 cubic yards of riprap.

The next 368 feet of the shore of the island is covered by the Castle Williams wall. This wall bears date of 1812 and was probably built in that year. The wall is in good condition.

The next is the sea wall completed in March, 1892; it is in good condition, but the foundation ought to be protected with about 450 cubic yards of riprap.

From the south end of this section, around the south and east sides of the island to the coal wharf, a distance of about 2,300 feet, the wall is in fair condition, but needs repointing over about an equivalent of 800 feet length of the wall, and in places the foundation requires protection with the riprap; about 900 cubic yards would be needed.

From the coal shed, following practically the present bulkhead line to the stone wharf, is a distance of 397 feet. About 212 linear feet of this distance is to be covered by the wall about to be begun. The remainder is now bounded by a decaying timber bulkhead, which ought to be replaced by a permanent wall, at an estimated cost of $8,000.

The amount thus required for repairs of existing sea walls and for completion of walls encircling the island, is:

For riprap, 2,000 cubic yards, at $2	$4,000
For pointing 1,717 linear feet of wall, estimated to cost $1 per foot	1,717
For 185 linear feet of new wall	8,000
Total	13,717

Money statement.

July 1, 1891, balance unexpended	$53,740.98	
Amount transferred from allotments for sea wall, Davids Island	6,597.86	
		$60,338.84
June 30, 1892, amount expended during fiscal year		46,484.70
July 1, 1892, balance unexpended		13,854.14
July 1, 1892, outstanding liabilities	$180.00	
July 1, 1892, amount covered by uncompleted contracts	4,956.56	
		5,136.56
July 1, 1892, balance available		8,717.58
Amount (estimated) required for completion of existing project		5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		5,000.00

Abstract of proposals for constructing sea wall at Governors Island, New York, in vicinity of wharves on east side of island, received in response to public notice circular, dated May 26, 1892, and opened June 16, 1892, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Rate per linear foot completed work.	Amount of bid (212 linear feet).
1	M. Flaherty, 411 W. Thirty-seventh street, New York City*	$23.38	$4,956.56
2	Francis H. Smith, 16 Exchange Place, New York City	39.60	8,437.60
3	John Cox, 791 Herkimer, street, Brooklyn, N. Y	37.34	7,916.08

NOTE.—Amount available for work, about $10,000.

* Lowest bid.

Abstract of contracts for sea walls at Governors Island, New York Harbor, in force during the fiscal year ending June 30, 1892.

Name and address of contractor.	Date of contract.	Subject of contract.	Price.
Breuchaud, Pennell & Co., Yonkers, N. Y.*	Nov. 26, 1890	Construction of sea wall and embankment.	Foundation per cubic yard, $11. Masonry wall per linear foot, $19. Embankment per cubic yard, 29 cents. Cramps and dowels per pound, 25 cents.
Breuchaud, Pennell & Co., Yonkers, N. Y., (supplementary to above.)*	Oct. 31, 1891	Substituting material taken from the island, and placed in embankment.	Per cubic yard, 24 cents.
M. Flaherty, 411 W. Thirty-seventh street, New York City.†	June 17, 1892	Sea-wall construction.	Per linear foot of completed wall, $23.38.

* Contracts completed March 10, 1892.

† In progress.

APPENDIX No. 3.

BEACH PROTECTION, WATER SUPPLY, AND SEWERAGE SYSTEM AT FORT MONROE, VIRGINIA.

REPORT OF MAJOR CHARLES E. L. B. DAVIS, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR FISCAL YEAR ENDING JUNE 30, 1892.

IMPROVEMENTS.

- *a* Beach protection at Fort Monroe, Virginia.
- *b* Water supply at Fort Monroe, Virginia.
- *c* Sewerage system at Fort Monroe, Virginia.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., July 9, 1892.

GENERAL: I have the honor to forward herewith my annual report for the year ending June 30, 1892, on fortifications in my charge.

Very respectfully, your obedient servant,

CHAS. E. L. B. DAVIS,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

3 A.

BEACH PROTECTION.

The beach forming the shore of Chesapeake Bay to the northeastward of Fort Monroe has for some years been subject to erosion by tidal currents and the action of the waves during northeast storms. The erosive action had progressed to such an extent that there was danger that this narrow strip of land, which connects Fort Monroe with the mainland, would be cut through. This strip of land, besides affording communication with the cemetery, is the only area of ground belonging to the reservation not occupied by buildings, and its preservation for military purposes is regarded as essential.

In order to protect the beach from further erosion, a project was submitted for the construction of jetties at suitable intervals along the beach, the cost of which was estimated at $37,000. An allotment of $10,000 for this object was made from the appropriation for preservation and repair of fortifications, and on February 24, 1891, an appropriation of $27,000 was made for this purpose. The jetties were at first constructed of a core of oyster shells covered with heavy riprap stone. In order to diminish the cost, the cheaper plan was subsequently adopted of a pile jetty consisting of a continuous row of piles and sheet-piling, oyster shells and riprap in much smaller quantity being placed on either side of the piles.

Under this project a contract had been made March 4, 1891, with F. J. Kelly for constructing pile jetties, and at the close of the fiscal year ending June 30, 1891, work under this contract was in progress. Operations were continued by the contractor from July to October, 1891, and closed during the last-named month; 830.5 linear feet of pile jetty were built under the contract. The work proceeded slowly and was greatly delayed by storms and bad weather. In order to hasten the work a pile-driving plant was erected by the United States and 570 linear feet of pile breakwater built between the light-house wharf and Jetty No. 1.

A sea wall 170 feet long was also built near the light-house wharf. At the close of the last fiscal year a contract was in force with the Fort Deposit Granite Company for delivering riprap stone for the jetties. The contract was entered into March 13, 1891, and the price was $2 a cubic yard. Delivery of stone was to be commenced April 1, 1891, but the contractors failed to deliver the stone in accordance with the contract time, after repeated notification to proceed with the work. Accordingly 643 cubic yards of stone were purchased in open market at $3 per cubic yard. A delivery under the contract was finally made August 26, 1891, and four cargoes, aggregating 545 yards were delivered up to October 22, 1891. The contract was then closed.

A second contract for riprap stone was also in force June 30, 1891, made on that date with the Westham Granite Company, of Richmond, Va., at $2.97 per cubic yard, under the appropriation of February 24, 1891. Deliveries under this contract commenced July 21, 1891, and continued until November 19, 1891, 3,687 cubic yards having been delivered.

The stone and oyster shells were put in place by hired labor.

Work has been in progress on four jetties, numbered 1 to 4 inclusive. No. 1 is about 900 feet above the light-house wharf and the other jetties are from 900 to 1,000 feet apart to the eastward.

Jetty No. 1 was built of oyster shells and stone and is 165 feet long. An attempt to lengthen it was made, but scour set in and the work was suspended.

Jetty No. 2 is built of oyster shells and riprap and is now 300 feet long.

Jetty No. 3, for a length of 127 feet, is built of oyster shells and riprap, and for a further length of 273 feet is built with a pile center as above described, with shells and riprap piled on either side. This jetty has two wings, one 21 and the other 73 feet long.

Jetty No. 4 is built with the pile center. The main jetty is 271 feet long, with a shore connection 64 feet long, built of shells and stone. This jetty has two wings, one 45 feet long and the other 168 feet long. During the severe storm of October 11, 12, 1891, a part of the pile center of this jetty was washed away before the riprap could be put in. Some of the sheet piling was also eaten off by the teredo. Work on the jetties was suspended in January, 1892, the available funds having been nearly exhausted.

There has been some fill on the east side of all the jetties, especially at No. 4. Between the jetties there has been a slight scour.

Money statement.

July 1, 1891, balance unexpended	$23,985.60
June 30, 1892, amount expended during fiscal year	23,656.07
July 1, 1892, balance unexpended	329.53
July 1, 1892, outstanding liabilities	89.00
July 1, 1892, balance available	240.53

---

3 B.

WATER SUPPLY.

An improved water supply at Fort Monroe is urgently needed. At the present time the only potable water to be obtained upon the reservation is rain water stored in cisterns. This, at the best, is an unsatisfactory source of supply, and during a very dry season is liable to fail entirely. To this danger may be added the equally serious one of contamination of the water so stored, resulting from the lack of a proper system of sewerage. The supply of fresh water is now supplemented by water obtained from driven wells on the west side of Mill Creek, and brought to the reservation in iron pipes. This water is of an inferior quality and is not fit for drinking purposes. The importance of abundant supply of pure water for the use of the garrison, the large force of employés of the United States, and citizens who visit the post, can not be overestimated. From a military point of view it is hardly necessary to say that is of vital importance that an adequate supply of good water, not liable to be cut off during time of war, should be had within the limits of the fortification. Such a supply, it has been thought, could be obtained by sinking an artesian well within the fort.

I subjoin the following summary of work done in former years in this direction.

PREVIOUS OPERATIONS.

The first effort to obtain water by an artesian well at Fort Monroe was made in 1846, when the original well was commenced. There were 225 feet of 8-inch pipe sunk, and inside of this 283 feet of 5-inch pipe. No record of the exact depth reached has been found. This well was abandoned in 1851.

In 1864–'65 Gen. B. F. Butler put down 340 feet of 12-inch pipe.

In 1867 Col. Henry Brewerton commenced sinking an 8-inch pipe within the 12-inch pipe of the well of 1864–'65, and a part of the 5-inch and 8-inch pipe of the well of 1845 was withdrawn and used in this work. On June 30, 1868, a depth of 370 feet had been reached. The sinking of the 8-inch pipe was continued until a depth of 517 feet below the surface of the parade of the fort was reached, when the lowest section of the pipe separated from the rest. It was found that a pipe 5½ inches in exterior diameter could be passed through the disjointed pipe, and it was decided to insert within the 8-inch cast-iron pipes, wrought-iron tubes of 4½ inches interior diameter with screw ends, and 585 feet of this tubing were successfully inserted. At a depth of 585 feet, the bottom of the clay stratum through which the auger had been passing was reached, and a stratum composed of about 90 per cent sand and 10 per cent of clay was reached. After passing into the sand, a water-bearing stratum was reached which yielded a limited amount of saline water, which when left undisturbed for twenty-four hours rose in the tubing to a height of 4 feet 6 inches above the level of the parade of the fort. On June 30, 1870, the well had been sunk 900 feet, and the 4½-inch tubing sunk 886 feet below the parade. Work was suspended in August, 1870, at which date the 4½-inch tubing had been forced down to a depth 898 feet below the parade, while the auger had penetrated to a depth of 906.5 feet below the same level. In November, 1871, operations were resumed, and a drill was substituted for the auger previously used. The 4½-inch tubing which had been left projecting about 15 feet above the ground was found to be full of water. The tube was tapped near the ground, and, on being plugged, the pipe was found to fill gradually. On pumping out the water to secure a dry tube for drilling, a sudden inrush of clay, coarse gravel, and shell filled the tube for about 120 feet from the bottom. After removing this with the sand pump, and attempting to drill, it was found that the lower section of the tubing was entirely detached. A passage for the drill was then cut through this section, but another influx of material moved the section, and but little progress could be made. The removal of the 4½-inch tubing was then commenced, and, on June 30, 1872, 664 feet had been taken out. Operations were soon after suspended for want of funds, and have not since been resumed.

FUTURE OPERATIONS.

In the annual report for June 30, 1890, an appropriation of $10,000 was recommended for the purpose of sinking a new well.

In the act of February 24, 1891, an appropriation of $6,000 was made, but as this was insufficient to cover the cost of sinking a well beyond a depth already demonstrated to be insufficient, no work has been done.

It is the opinion of Prof. W. J. McGee, of the U. S. Geological Survey, that artesian water will probably be found at Fort Monroe at a depth of about 1,200 feet.

In work of this character it is important that all of the funds needed for the well should be in hand before operations are commenced, and it is, therefore, recommended that the additional appropriation of $4,000 be made.

Money statement.

July 1, 1891, balance unexpended	$6,000.00
July 1, 1892, balance unexpended	6,000.00
Amount (estimated) required for completion of existing project	4,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	4,000.00

3 C.

SEWERAGE SYSTEM.

The sewerage system of Fort Monroe is seriously defective. It drains only the buildings within the walls of the fort, while for the drainage of the quarters outside there is no provision whatever. The sewers have not sufficient inclination to make them self-cleansing and are often obstructed. The main sewer alone is flushed by tidal water impounded in the moat, and discharges the sewage into Mill Creek, where it is often washed up along the shore and becomes a nuisance. As a result of the existing conditions the health of the garrison suffers, and numerous cases of typhoid fever are reported—a disease formerly unknown at the post.

On July 28, 1888, Lieut. Col. P. C. Hains made a report upon the existing sewerage system—which he stated to be defective—and submitted a plan for a new system for draining the fort alone, the sewage to be pumped into Chesapeake Bay. The estimated cost of this system was $33,000.

On March 2, 1889, Congress made an appropriation of $25,000 "for the construction, complete, of a sewerage system."

Specifications for a complete system were prepared and proposals invited by public advertisement. The lowest bid received was $35,749.48, but this did not conform to the specifications. As all of the bids exceeded the appropriation made by Congress, they were rejected.

The question of the drainage of the quarters and buildings outside the fort, and also of the several hotels authorized to be built by acts of Congress, has since been the subject of consideration. Various plans and projects looking either to the construction of a combined system providing for the drainage of all these buildings or of two separate systems, one for the hotels and one for the quarters, have received attention. In the event of the construction of a combined system, the manner in which the cost of such a system should be met by the several interests involved, has likewise been considered. On October 29, 1891, the Secretary of War decided that two separate systems should be constructed, one by the United States and the other by the hotel proprietors and others who enjoy the privilege of residence on the reservation. The existing appropriation of $25,000 would only be sufficient, it was found, for draining the fort proper and discharging the sewage into Mill Creek or Hampton Bay, and would not provide for the drainage of the quarters outside the fort. Such a system would be unsatisfactory and incomplete. Estimates were therefore prepared for a system to drain both the quarters and public buildings within and those without the fort, the sewage to be discharged by pumping into Chesapeake Bay. The estimated cost of such a system was $45,000, and on March 12, 1892, it was recommended that an additional appropriation of $20,000 be asked for with such legislation as might be necessary to render available the $25,000 appropriated March 2, 1889, for a "complete" system.

Money statement.

July 1, 1891, balance unexpended	$24,902.10
July 1, 1892, balance unexpended	24,902.10
Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894.	20,000.00

APPENDIX No. 4.

REPAIR AND PRESERVATION OF FORT MARION, ST. AUGUSTINE, FLORIDA.

REPORT OF MAJOR JOHN C. MALLERY, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR FISCAL YEAR ENDING JUNE 30, 1892.

UNITED STATES ENGINEER OFFICE,
St. Augustine, Fla., July 11, 1892.

GENERAL: I have the honor to transmit herewith my annual reports on Forts * * and Marion, Fla., for the fiscal year ending June 30, 1892.

Very respectfully, your obedient servant,

J. C. MALLERY,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

REPAIR AND PRESERVATION OF FORT MARION.

Fort Marion, St. Augustine, Fla., was built during the Spanish possession. It was at first named Fort San Augustin and later Fort San Marcos. For a description and an historical sketch of the work attention is invited to the annual report for 1889.

The work is not available for defense.

In the act approved July 5, 1884, $5,000 was appropriated for the preservation of the fort and the inclosure of its grounds. With this appropriation a picket fence was built along a portion of the reservation boundary line, the sea wall and covered way breast-height walls repaired, the bastion towers renewed, the interior walls refaced where necessary, the ramp rebuilt, and a portion of the terreplein covered with a waterproof pavement for the protection of the casemates. In all of the repairs the original designs were followed as closely as possible.

Under allotment from the appropriation for "preservation and repair of fortifications," the following repairs to the permanent work were made, viz: A short length of the sea wall at the north end of the fort and the north end of the water battery, which had been partly undermined by wave and current action, was protected; the sally port, the terreplein of the southwest bastion, and about two-thirds of the terreplein of the south curtain were covered with a waterproof pavement; a concrete drain was constructed under the sally port; the two sentry towers on the south face were repaired; a portion of the inner parapet wall of the east curtain was rebuilt; the two bridges leading to the fort were rebuilt, and a new floor was laid in casemate No. 4.

In the act of August 18, 1890, $15,000 was appropriated for this fort. Work under this appropriation was done by hired labor, using materials purchased by contract. It was begun on October 20, 1890, and continued to the close of the fiscal year. For details of the work see pages 533 and 534 of the Annual Report of the Chief of Engineers for 1891.

In order to complete the work of restoration of the fort and of improvement of the grounds, the recommendation of Capt. W. M. Black, Corps of Engineers, is renewed, that the flimsy modern doors of the casemate should be replaced by doors similar to that in casemate No. 7; a neat spiral iron staircase should be placed in the watchtower; the restoration of the chapel doorway should be completed; the drawbridge at the entrance should be restored; the wooden picket fence around the reservation should be replaced by a concrete wall; 2,460 linear feet additional of concrete walks should be built; neat iron benches should be placed at intervals in the grounds, and additional shrubbery should be set out. If the trespassers on the north boundary of the reservation are removed the sea wall will have to be extended and a slight additional fill made. The total estimated cost of these improvements is $6,500. None of these items, excepting the restoration of the chapel doorway, were included in former estimates. The desirability of these improvements developed as the work first laid out progressed. It is proposed to make a partial restoration of the chapel door should funds for the work become available; but the design as shown on the blue print of the original drawing, dated 1785, is too elaborate to be reproduced entirely.

During the fiscal year ending June 30, 1892, the entire terreplein was coated with a mixture of paraffin and petroleum; drawings for the restoration of the chapel door were made; 430 Spanish bayonets, 105 myrtles, 20 palmettos, and 62 elms were planted on the reservation. A covered drain, 6 inches square inside, made of 2-inch plank, was laid for a distance of 260 feet. This drain empties into the ditch near the city gates. Sixty feet of pavement on the grounds of the reservation having settled, on account of its having been laid over ground where considerable filling had been done, was brought up to its proper level. The fort-keeper has been kept busy cutting grass and weeds on the reservation. Some of the trees having died, the dead ones have been replaced by the contractor.

Money statement.

July 1, 1891, balance unexpended	$1,218.00
June 30, 1892, amount expended during fiscal year	1,171.47
July 1, 1892, balance unexpended	46.53
July 1, 1892, outstanding liabilities	28.45
July 1, 1892, balance available	18.08
Amount (estimated) required for completion of existing project	6,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	6,500.00

APPENDIX No. 5.

POST OF WILLETS POINT, NEW YORK; UNITED STATES ENGINEER SCHOOL; BATTALION OF ENGINEERS; ENGINEER DEPOT.

REPORT OF LIEUTENANT-COLONEL W. R. KING, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

UNITED STATES ENGINEER SCHOOL,
Post of Willets Point, New York Harbor, July 25, 1892.

GENERAL: I have the honor to submit the following annual report on the post of Willets Point, New York Harbor; the United States Engineer School, the Battalion of Engineers, and the Engineer Depot.

Very respectfully, your obedient servant,

W. R. KING,
Lieutenant-Colonel of Engineers, Commanding.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

I.—POST OF WILLETS POINT.

At the close of the fiscal year the garrison consisted of 24 commissioned officers and 353 enlisted men, including the following general staff, and infantry officers:

Maj. Clarence Ewen, surgeon, U. S. Army.
Capt. W. Fitzhugh Carter, assistant surgeon, U. S. Army.
First Lieut. John A. Perry, Eighth Infantry.
Second Lieut. William F. Martin, Twenty-fifth Infantry.
Second Lieut. Charles G. Dwyer, Twenty-first Infantry.
Second Lieut. Harry D. Humphrey, Twentieth Infantry.
Second Lieut. Frederic A. Tripp, First Infantry.
Second Lieut. John C. Gregg, Sixteenth Infantry.
Second Lieut. Edward R. Chrisman, Second Infantry.

The following-named officers were relieved from duty at this post (instruction in submarine mining) on the dates set opposite their respective names, viz:

Class 1890-'91.

Capt. Quincy O'M. Gillmore, Eighth Cavalry, October 1, 1891.
First Lieut. Charles H. Cochran, Seventh Infantry, October 1, 1891.
Second Lieut. Samson L. Faison, Thirteenth Infantry, October 1, 1891.
Second Lieut. Herbert S. Whipple, Tenth Cavalry, October 1, 1891.
Second Lieut. Walter H. Gordon, Twelfth Infantry, October 1, 1891.
Second Lieut. James H. Frier, Seventeenth Infantry, October 1, 1891.
Second Lieut. Herman Hall, Fourth Infantry, October 1, 1891.
Second Lieut. Alfred M. Hunter, Fourth Artillery, September 25, 1891.

Seven infantry officers were assigned to duty at this post in paragraph 30, Special Orders, No. 251, Headquarters of the Army, Adjutant-General's Office, Washington, October 28, 1891.

Capt. W. Fitzhugh Carter, assistant surgeon, U. S. Army, joined post January 30, 1892, in compliance with Special Orders, No. 12, Headquarters of the Army, Adjutant-General's Office, Washington, January 13, 1892, and was assigned to duty at post hospital in Orders, No. 15, Post of Willets Point, January 30, 1892.

Capt. Henry S. Kilbourne, assistant surgeon, U. S. Army, was relieved from duty at post hospital in Orders, No. 12, Post of Willets Point, January 23, 1892, in compliance with Special Orders, No. 10, Headquarters of the Army, Adjutant-General's Office, Washington, January 13, 1892. Left post January 23, 1892.

The building of two new brick barracks and a guardhouse by the Quartermaster's Department, which were well under way at the close of the year, will supply long-felt needs of the post, and it is to be hoped that provisions will be made for the third barrack from funds now available.

The new brick engine house for fire engines and appliances is nearly completed and will doubtless prove well adapted to its purpose.

The roads and sidewalks of the post have been kept in fair condition by adding broken trap rock to the former and screenings to the latter. About 1,300 feet of new sidewalk has been built, extending from near the officers' mess building to the guardhouse. This walk is partly of brick and partly of screenings from the stone-crusher.

A section of the iron fence, received some time ago, has been set up, with a solid concrete base, along the line east from the gate and extending to the ditch.

All of the foregoing improvements have been made by Lieut. Jervey, post quartermaster, from funds allotted by the Quartermaster's Department.

The lighting of the public buildings and grounds by electricity, the cleaning-out of the ditch which bounds the Government lands on the southwest, the walling-in of the ice pond so as to exclude surface water, and the building of a quartermaster and commissary storehouse near the wharf, as recommended in my last report and for each of which items plans and estimates have been made, are respectfully recommended.

In September last, on my recommendation, the honorable Postmaster-General established a post-office at this place, which has been found of great convenience in the transaction of official business and has recently been declared a money-order office, the amount of revenue from it having reached the necessary figure for that purpose.

II.—UNITED STATES ENGINEER SCHOOL.

The scope and object of the school have been fully set forth in previous reports and in the order establishing it on its present basis; the orders issued in pursuance of the latter, arranging the details of the season's work, are appended, marked A, B, and C.

During the present year a class of five engineer officers completed the full course of two and one-half years and one officer of the artillery, two officers of the cavalry, and five officers of infantry completed their course of torpedo instruction.

* * * * * * *

III.—BATTALION OF ENGINEERS.

The law provides for five companies of engineer troops, having an aggregate strength of 752 enlisted men, officered by detail from the Corps of Engineers. At present only four companies, with a total strength of 500 enlisted men, are allowed to be recruited.

The aggregate strength of the battalion on June 30, 1892, including Company E, stationed at West Point, was 18 commissioned officers and 437 enlisted men.

During the year Companies A, B, and C have been stationed at Willets Point. Company D exists in name only. Company E has been stationed at West Point to assist in the practical instruction of cadets of the Military Academy, in building military bridges, sapping, mining, and signaling.

* * * * * * *

Second Lieutenant Robert McGregor, Corps of Engineers, was appointed acting battalion adjutant August 12, 1891, in Orders, No. 74, Battalion of Engineers, August 8, 1891; relieved from course of instruction at U. S. Engineer School, August 12, 1891, in Orders, No. 139, Post of Willets Point, August 13, 1891; appointed adjutant, Battalion of Engineers, October 21, 1891, in Orders, No. 99, Battalion of Engineers, October 21, 1891.

Second Lieutenant Jay J. Morrow, Corps of Engineers, was transferred from Company C to Company A, Battalion of Engineers, April 10, 1892, in Orders, No. 51, Battalion of Engineers, April 10, 1892.

The following table shows the changes that have taken place in the personnel of the officers during the year, viz:

Rank.	Name.	Date.	Relieved or joined.	Remarks,
First lieutenant	Warren, James G	Aug. 12, 1891	Relieved	S. O. 177, A. G. O., Aug. 3, '91.
Second lieutenant	Cosby, Spencer	Oct. 1, 1891	Joined	S. O. 210, A. G. O., Sept. 10, '91.
Do	Sewell, John S	do	do	Do.
Do	Echols, Chas. P	do	do	Do.
Do	McIndoe, James S	do	do	Do.
Do	Morrow, Jay J	do	do	Do.
Captain	Bergland, Eric	Nov. 11, 1891	Relieved	S. O. 247, A. G. O., Oct. 23, '91.
Do	Black, William M	Nov. 29, 1891	Joined	Do.
First lieutenant	Shunk, Francis R	Feb. 29, 1892	Relieved	S. O. 45, A. G. O., Feb. 24, '92.
Do	Patrick, Mason M	Apr. 25, 1892	Joined	S. O. 83, A. G. O., Apr. 8, '92.
Do	Lucas, E. W. VanC	Apr. 27, 1892	Relieved	Do.
Second lieutenant	Winslow, Eben E	May 16, 1892	do	S. O. 112, A. G. O., May 12, '92.
Do	D'Armit, Albert M	do	do	Do.
Do	Harding, Chester	do	do	Do.
Do	Harts, William W	do	do	Do.
Do	Flagler, Clement A. F.	do	do	Do.

RECRUITING, DISCIPLINE, ETC.

During the year recruits for the battalion have been obtained by enlistments at Willets Point and West Point and by assignment on their own application from recruiting rendezvous or other branches of the service.

An engineer sergeant was detailed to recruit for the Battalion of Engineers on September 29, 1891, under authority granted in letter from the Adjutant-General, U. S. Army, dated September 15, 1888, and was attached by the Superintendent Recruiting Service to rendezvous, 146 Park Row, New York City. He was relieved from this duty March 12, 1892, only 46 recruits being at that time required to complete the authorized strength of the companies at this post, a number which is as large as can be quartered in the old barracks without uncomfortable crowding.

The following is a statement of changes among the enlisted men of the battalion during the past year:

Gain:		
Recruits from depot		35
Enlisted in the battalion (Willets Point, 61; West Point, 22)		83
Reënlisted (Willets Point, 37; West Point, 5)		42
By transfer		4
From desertion		4
Total gain		168
Loss:		
Discharged by expiration of service		57
Discharged for disability		6
Discharged by sentence of general courts-martial		13
Discharged by order	9	
Discharged by order (General Orders, 80, Adjutant-General's Office, series 1890)	14	
Discharged by order (General Orders, 81, Adjutant-General's Office, series 1890)	11	
		34
Transferred (hospital corps, 1; other causes, 7)		8
Retired		3
Died		3
Deserted		24
Total loss		148
Net gain		20

The following table gives a comparative statement of recruiting, desertions, etc., during the past eight years:

Fiscal year.	No. of men on June 30.	Recruiting.		Average daily number.		Desertions.	Trials.		
		Enlisted.	Reënlisted.	Arrest or confinement.	Sick.		General courts-martial.	Garrison courts-martial.	Summary courts.
June 30, 1884–June 30, 1885	383	56	30	6	18	106	11	59	......
June 30, 1885–June 30, 1886	396	57	38	8	22	76	20	107	......
June 30, 1886–June 30, 1887	388	20	28	9	17	49	19	160	......
June 30, 1887–June 30, 1888	387	9	24	12	22	49	21	218	......
June 30, 1888–June 30, 1889	402	90	29	6	20	23	4	214	......
June 30, 1889–June 30, 1890	468	147	64	9	14	52	13	304	......
June 30, 1890–June 30, 1891	417	50	59	6	12	15	12	60	138
June 30, 1891–June 30, 1892	437	83	42	5	10	14	19	4	208

The table shows that the enlisted strength of the battalion is greater than at any time in the last eight years, except in 1890; that the number of enlistments has been about double the average number; the number of reënlistments has been slightly above the average, while the number in arrest or confinement and the number of sick are smaller than at any other time during the period considered.

The number of desertions is larger than last year, but is still below the average and is slightly less, compared with the number of recruits, than it was last year.

The number of trials by court-martial is a little larger than it was last year, but it includes many cases of trial for minor offenses which were formerly punished by company commanders without trial.

The summary court continues to work well, and it is seldom that a prisoner demands a trial by other courts.

The following statement shows the number of different men tried by court-martial and other facts relative to the trials:

	Trials.
By general court	19
By summary court	208
Objected to trial by summary court and tried by garrison court	4
Total	231

	No. of men.	No. of trials.
Tried once	75	75
Tried twice	20	40
Tried three times	15	45
Tried four times	12	48
Tried five times	2	10
Tried six times	1	6
Tried seven times	1	7
Total	126	231

Number of men who pleaded guilty	176
Number of men who pleaded not guilty	55
Total	231
Number of acquittals	10
Number found guilty	221
Total	231

The combined mess of the three companies and band has not only been successfully operated, but has been greatly improved during the year by Lieut. Jadwin, who has given it his close personal attention, and nothing is now required but a suitable building to make this important agency for the soldiers' welfare all that could be desired.

The Post Exchange has also improved during the year and has been carefully looked after by Lieutenants Harding and Cosby. The suggestions of the council and of the committees of enlisted men have been carried out as far as practicable, and it is hoped that a more suitable building will be available when the new barracks are completed. Steps will be taken at an early day to fit up at least a temporary gymnasium and a bowling alley for the enlisted men, as it is believed that a portion of the proceeds of the post exchange can be advantageously applied in that way.

For the reasons given in my last report, which have been confirmed by the last year's experience, I would respectfully renew my recommendations that the present complicated system of discharging good men after three years' service, while holding on to the bad ones, be changed by simply reducing the term of enlistment to three years, and that the 11 o'clock roll call be changed to 10 o'clock or, still better, to 9:30. Both of these changes, it is believed, would result in "the greatest good to the greatest number" and would prove a great benefit to the service.

DRILLS AND INSTRUCTIONS.

During the year the Battalion of Engineers has been drilled and instructed as follows:

1. In infantry tactics: School of the soldier, company, and battalion (new drill regulations).

2. In target practice: The practice season for the post of Willets

Point, New York Harbor, for the past year was from September 25 to October 31, 1891, and at West Point, N. Y., during the months July and August, 1891. Owing to objections by citizens living in the neighborhood to the use of the rifle range at this post, no regular target practice could be had.

A suitable butt with targets for firing at short ranges and with reduced charges was built at this post during July and August, 1891. Target practice was held daily by companies in turn, superintended by the company commanders. The practice was limited to those men who had no firing record in their company.

3. In pontooniering during the months of October and November.

4. Military engineering: Foot reconnoissance, tracing and profiling field fortifications, construction of spar bridges, double lock (including knots and lashings), during the month of November, 1891.

5. Torpedo drills were had throughout the year, the winter months being devoted to indoor drills and practice in the loading room and the summer months to outdoor drills and exercises.

The following number of men received instruction during the winter months, viz: 15 sergeants, 32 corporals, 239 privates.

Qualification of privates:	
First-class and qualified	196
Second-class	38
Third-class	5
	239

Five men received no instruction during indoor season: 1 post baker, already rated qualified; 3 men on three months' furlough; 1 man in confinement during the entire season.

During the summer months five grand groups were planted, which required five different details by roster, each detail consisting of 3 commissioned officers, 3 noncommissioned officers, and 12 privates.

6. Photography: Selected details of noncommissioned officers have been instructed in military photography.

7. In order to facilitate the learning of the various industrial trades by enlisted men and to furnish men qualified for special duty as carpenters, blacksmiths, engine drivers, etc., a detail of four men from each company was employed, under supervision of Lieut. Sewell, to act as assistants to the mechanics at work in the different shops on the post, when not on other duty. This duty was voluntary and the men were allowed to select the trade they were to learn. If they made satisfactory progress, they were considered eligible for special details when vacancies occur; but, if not, they were replaced by others, and a record was kept of the progress made by each man for future reference.

8. In telegraphy and signaling a class of 12 enlisted men was instructed by Lieut. Harding, and considerable progress was made.

9. The post schools for enlisted men and children living on the post were under the supervision of Lieut. Winslow and have been well conducted. Sixty enlisted men and 48 children between the ages of five and fifteen have received appropriate instruction.

I would respectfully renew my recommendation that the pay of all grades of noncommissioned officers in the Battalion of Engineers be increased to the following rates, viz:

Sergeant-major and quartermaster-sergeant	$60.00
First sergeant	50.00
Sergeant	40.00
Corporal	25.00

These rates are not higher than the increased skill, intelligence, and responsibility of the duties call for, and they are much less than many of these men can readily obtain in civil life.

I would also respectfully recommend that the grade of first sergeant of engineers be authorized by law and that one chief musician and two principal musicians be authorized for the Battalion of Engineers, the same as for other regimental organizations.

ENGINEER DEPOT.

PUBLIC BUILDINGS AND STRUCTURES.

I. The fireproof storehouse for pontoon, siege, and torpedo materials, referred to in last report, has been so nearly completed that the work of removing and placing in this building the large quantities of property to be stored in it is now well under way.

The building is 40 by 120 feet outside, with a dry and airy basement, the walls being of stone and brick with concrete floors, one of which rests upon solid ground and the other upon heavy steel girders and brick arches.

The roof is covered with slate, supported upon strong iron trusses, the underside of the purlins, which are of cypress, being sheathed with corrugated iron, galvanized, securely nailed to the purlins in such a manner as to carry to the side of the building any water that may possibly leak through or be deposited from the atmosphere on the underside of the slate. The walls have been thoroughly painted on the outside, and during the recent extremely damp weather they were perfectly dry on the inside.

II. The small steam tug for planting torpedoes, and for which plans were made last year, has been placed under contract with Messrs. J. S. Ellis & Son and is to be completed by the 30th of September next.

III. The work of gradually replacing the old and worn-out pontoon materials has been continued and a quantity of excellent pine and oak lumber has been procured, which will be sufficient to make twenty boats and balk and chess for 400 linear feet of bridge, in addition to the 300 linear feet already on hand. Cordage and mooring rope, lashings, etc., have also been procured, and about 7,500 feet B. M. of assorted cedar, cypress, and oak timber for repairing row boats.

IV. The buildings for boiler, engine, and dynamos for the trials of the new Sims-Edison torpedo were completed and the machinery was placed in position and used during the many runs made with the torpedo. Every part of this plant worked to perfection and no difficulty whatever was encountered in using it.

V. A concrete tank for wet storage of insulated torpedo cable was built between the ice house and the engineer stables, and at such a level that it can be filled and emptied by gravity, the water supply being taken from the ice pond.

Thirty-four drums of the multiple cable, bought through Maj. Post, have been placed in this tank and a small building for testing instruments has been erected near the tank, so that the cables can be tested at any time with the greatest facility.

VI. The usual work of printing, bookbinding, drafting, photographing, lithographing, engine-driving, repairs of depot buildings and boats, and the general work of keeping property and buildings in a proper state of preservation have been performed, with some few exceptions, by enlisted men of the Engineer Battalion, detailed on extra duty for the purpose at an aggregate cost of $3,424.47.

DEPOT PROPERTY.

The depot property includes the pontoon-bridge equipage and tools, materials, and appliances required for experiments and instruction of engineer troops in land and submarine mining, astronomical and surveying instruments, and torpedo materials for seacoast defense.

The various kinds of instruments on hand have been properly cared for, and the following additions have been made during the year by purchase under formal proposals, viz:

Three engineer transits, 20 odometers, 20 binocular field glasses, 20 prismatic compasses, 1 planimeter, 4 clinometers, 10 steel tapes, 10 engineer scales, and 2 measuring instruments.

All the above at a cost of $1,247.60.

The receipts and issues during the past year of instruments for the use of officers engaged on surveys, reconnoissances, and other public works were continued, and included quite a number of instruments overhauled and issued for use on the International Boundary Survey, now in progress between the United States and Mexico.

The following instruments were issued, upon requisitions, duly authorized by the Chief of Engineers, U. S. Army, viz.:

One astronomical transit and zenith telescope combined, 2 astronomical transits, 3 zenith telescopes, 2 artifical horizons, 2 heliotropes, 5 engineer transits, 1 chronograph, 3 theodolites, 3 surveyors' levels, 2 sextants, 7 chronometers, 21 prismatic compasses, 13 odometers, 11 aneroid barometers, 2 barometers, mercury cistern, 1 case of instruments for repairs of barometers, 2 level rods, 4 binocular field glasses, 1 planimeter, 10 steel tapes, 10 engineer scales, 4 clinometers, 6 protractors, 1 rain-gauge, 1 thermometer, 1 psychrometer, and a number of other instruments which were temporarily issued to surveying parties for surveying portions of Long Island and for hydrographic surveys of the Long Island Sound in the vicinity of this post.

The following instruments were received during the year from officers on surveys and public works, viz:

Five theodolites, 1 theodolite-transit, 3 transits, 1 telescope, 1 watch, 4 aneroid barometers, 4 surveyors' compasses, 1 surveyors' level, 19 odometers, 10 prismatic compasses, 5 sets drawing instruments, 3 chains, 3 sets of pins, and 1 chronometer.

These instruments, when returned to the depot from field service, usually require considerable repairs before they are fit for reissue, and some of them are so much worn that they are not worth repairing, in which case they are inspected and condemned and useful parts of the same are used for repairing other instruments.

Most of the repairing to instruments during the past year has been performed by enlisted men of the engineer battalion, detailed on extra duty for the purpose, and some of whom acquire sufficient skill to clean and repair almost any instruments required for our service.

The following instruments have been overhauled and repaired in the depot repair shop, viz:

Six engineer transits, 1 theodolite, 3 astronomical transits, 1 chronograph, 1 electrical clock, 2 current-meters, 1 chronometer, 6 aneroid barometers, 4 zenith telescopes, 1 self-registering tide-gauge, 4 steel tapes, 3 binocular field glasses, 4 boat compasses, 6 prismatic compasses, 1 electric shutter for photographic camera, 22 circuit-closers, 22 circuit-regulators, 8 galvanometers, and a large number of other instruments of minor importance.

Some of these instruments required thorough overhauling and repairing and others needed only minor repairs.

The cost of extra-duty pay for this work amounted, during the fiscal year, to $287, and the cost of the necessary materials to $73.75, or $360.75 in all.

No issues have been made during the year under the authority heretofore given to issue surplus tools to officers in charge of public works, as they have all been disposed of except axes and picks, of which there is a large stock on hand that will probably not be needed here for many years to come.

EXPERIMENTS.

I. *Sims-Edison fish torpedo.*—The new fish torpedo made by the Sims-Edison company under contract of March 24, 1891, was delivered in July last, and after being set up by Mr. Sims was tested in some thirteen runs and dock trials during the year.

* * * * * * *

II. *Cable tests.*—Many tests of submarine cable have been made during the year by Lieuts. Jervey, D'Armit, and Hunter, for the purpose of ascertaining the condition of cables in store and of special cables and sample coils kept under water for trial of the wet storage method.

III. Circuit-closers and self-acting mine mechanisms have been made a special study by Lieut. Jadwin, and his experiments have shown great ingenuity as well as personal interest.

IV. A new form of electric-current meter, made by Mr. F. E. Brandis, was tested and reported on by Capt. Bergland, who pointed out certain defects that the maker has endeavored to correct. This meter will be still further tested during the hydrographic surveys of the present season.

V. Samples of building stone and cement have been tested by Lieut. D'Armit, and two of his reports on stone tested for Col. Craighill and Capt. Fiebeger are forwarded herewith, marked D.

VI. A variety of electric fuses that have been on hand several years were tested and reported on by Lieut. Cochran, with a view to ascertaining their durability and fitness for use in blasting.

VII. Other special tests have been made from time to time, among which may be mentioned a new steel mooring rope and a comparative test of the socket shackle referred to in a former report, and the loop and thimble method of attaching mooring ropes. A copy of Lieut. D'Armit's report on these tests is forwarded herewith, marked E.

VIII. A series of experiments was made during the months of April, May, and June on the hygrometric condition of a mining casemate and a service magazine, the results of which were forwarded with my report for the month of June, 1892.

STATEMENT OF FUNDS.

I. *Engineer depot at Willets Point, New York.*—Congress appropriated for the fiscal year ending June 30, 1892—

1. For incidental expenses of depot (incidentals)	$5,000.00
2. For instruction of battalion (materials)	3,500.00
3. For purchase and repair of instruments (instruments)	2,000.00
4. For purchase and binding of professional works of recent date on military and civil engineering (library)	500.00
Total	11,000.00

Of this there has been expended and pledged—

1. For incidental expenses of depot (incidentals)	$4,996.75
2. For instruction of battalion (materials)	3,500.00
3. For purchase and repair of instruments (instruments)	2,000.00
4. For purchase and binding of professional works of recent date on military and civil engineering (library)	500.00
Total	10,996.75

The following item from the act approved February 24, 1891, and designated for the engineer depot at Willets Point, N. Y., was assigned to me for disbursement and is available until expended:

5. For a fireproof building to replace engineer depot storehouse destroyed by fire May 10, 1890 (storehouse)	$16,000.00
June 30, 1892, amount expended during fiscal year	12,468.34
July 1, 1892, balance unexpended	3,531.66
July 1, 1892, outstanding liabilities	558.15
July 1, 1892, balance available	2,973.51

II. *Torpedoes for harbor defense* (*act September 22, 1888*).—Congress appropriated under the above act the sum of $200,000, from which the amount of $98,000 has been assigned to me for disbursement and is available until expended:

July 1, 1891, balance unexpended		$17,316.75
June 30, 1892, amount expended during fiscal year	$5,484.60	
June 30, 1892, amount withdrawn and restored to original appropriation	6,743.82	
		12,228.42
July 1, 1892, balance unexpended		5,088.33
July 1, 1892, balance available		5,088.33

III. *Torpedoes for harbor defense* (*act March 2, 1889*).—The act of Congress making appropriations for fortifications, etc., approved March 2, 1889, appropriated, under the general title "Torpedoes for harbor defense," the sum of $250,000 for purchase of submarine mines and necessary appliances, and $30,000 for torpedo experiments and instruction of engineer troops in submarine mining. These amounts were assigned to me for disbursement and are available until expended:

1. July 1, 1891, balance unexpended		$96,488.93
June 30, 1892, amount expended during fiscal year	$12,120.34	
June 30, 1892, amount withdrawn and restored to original appropriation	54,859.26	
		66,979.60
July 1, 1892, balance unexpended		29,509.33
July 1, 1892, outstanding liabilities	4,509.91	
July 1, 1892, amount covered by uncompleted contract	6,950.00	
		11,459.91
July 1, 1892, balance available		18,049.42

2. From the appropriation for purchase of movable submarine torpedoes, act of March 2, 1889, the sum of $25,225 was assigned to me for disbursement and is available until expended:

July 1, 1891, balance unexpended, but pledged on account of Sims-Edison fish torpedo contract	$25,225.00
June 30, 1892, amount expended during fiscal year, part payment on the above contract	3,125.00
July 1, 1892, balance unexpended	22,100.00
July 1, 1892, amount covered by uncompleted contract	22,100.00

3. The following item from the appropriation for "Torpedoes for harbor defense," act March 2, 1889, for "Submarine mines and necessary appliances," was assigned to me for disbursement and is available until expended:

For the construction at Willets Point of concrete tanks for the wet storage of submarine cable	$5,000.00
June 30, 1892, amount expended during fiscal year	1,733.88
July 1, 1892, balance unexpended and available	3,266.12

IV. *Torpedoes for harbor defense* (*act August 18, 1890.*)—Under the above act the following amounts were assigned to me for disbursement and are available until expended, viz:

1. For submarine mines and necessary appliances for storage at Hampton Roads and Portland, Me., and charge bags for Boston, New York, and San Francisco		$100,000.00
July 1, 1891, balance unexpended		23,757.84
June 30, 1892, amount expended during fiscal year	$1,880.75	
June 30, 1892, amount withdrawn and restored to original appropriation	18,131.44	
		20,012.19
July 1, 1892, balance unexpended		3,745.65
July 1, 1892, outstanding liabilities		2,137.50
July 1, 1892, balance available		1,608.15
2. For continued torpedo experiments, etc.:		
July 1, 1891, balance unexpended		30,000.00
June 30, 1892, amount withdrawn and restored to original appropriation		7,009.30
July 1, 1892, balance unexpended and available		22,990.70

V. *Torpedoes for harbor defense* (*act February 24, 1891.*)—Under the above act the amount of $21,695 for tool boxes, etc., for storage at Willets Point, N. Y., and for submarine mines and necessary appliances for storage at Charleston Harbor, was assigned to me for disbursement and is available until expended:

July 1, 1891, balance unexpended		$16,742.08
June 30, 1892, amount unexpended during fiscal year	$13,995.23	
June 30, 1892, amount withdrawn and restored to original appropriation	1,913.15	
		15,908.38
July 1, 1892, balance unexpended		833.70
July 1, 1892, outstanding liabilities		750.00
July 1, 1892, balance available		83.70

VI. *Torpedoes for harbor defense.*—The following amounts, which were withdrawn and restored to their original appropriations, have been reallotted under date of February 13, 1892, and will be applied to the purchase of American submarine torpedo cable; these amounts were assigned to me for disbursement and are available until expended, viz:

1. Submarine mines and necessary appliances (act March 2, 1889)	$49,859.26
2. Submarine mines and necessary appliances (act August 18, 1890)	18,131.44
3. Torpedo experiments and instruction of engineer troops, etc. (act August 18, 1890)	7,009.30
Total	75,000.00
June 30, 1892, withdrawn on account of item 2	38.88
July 1, 1892, balance unexpended and available	74,961.12

NEW APPROPRIATIONS.

The following items have been appropriated for the engineer depot at Willets Point, N. Y., for the fiscal year ending June 30, 1893, viz:

1. For incidental expenses of depot (incidentals)	$4,000.00
2. For instruction of battalion (materials)	3,500.00
3. For purchase and repair of instruments (instruments)	2,000.00
4. For purchase and binding of professional works of recent date on military and civil engineering (library)	500.00
5. For purchase of pontoon materials	5,000.00
Total	15,000.00

ESTIMATES.

There will be required for the fiscal year ending June 30, 1894, the following for engineer depot at Willets Point, N. Y., viz:

1. For incidental expenses of depot, including fuel, light, chemicals, stationery, hardware, extra-duty pay to soldiers necessarily employed as artificers on work in addition to, and not strictly in the line of, their military duties, such as carpenters, clerks, draftsmen, blacksmiths, printers, bookbinders, photographers, lithographers, engine-drivers, teamsters, wheelwrights, masons, machinists, painters, overseers, and laborers, and for materials to repair public buildings, machinery, and unforeseen expenses	$5,000.00
2. For purchase of materials for the instruction of engineer troops at Willets Point in their special duties as sappers and miners, for land and submarine mines, and pontoniers, torpedo drill, and signaling	3,500.00
3. For purchase and repair of instruments to be issued to officers of the Corps of Engineers and to officers detailed on duty as acting engineer officers for use on public works, surveys, and reconnoissances	3,000.00
4. For library of Engineer School: For purchase and binding of professional works of recent date treating of military and civil engineering and kindred scientific subjects	500.00
Total	12,000.00

Appendix A.—Programme of Study and Instruction for Winter Season.

[Printed Orders, No. 217.]

United States Engineer School,
Post of Willets Point, New York Harbor, November 24, 1891.

I. The following programme of study and instructions for the ensuing winter season, commencing Tuesday, December 1, 1891, and ending April 26, 1892 (a period of twenty-one weeks), having been recommended by the academic staff and approved by the Chief of Engineers, will be carried into effect:

COURSE FOR OFFICERS.

1. Examinations by the academic staff will be held at the end of January and April, and intermediate examinations, as nearly monthly as practicable, will be held by committees of the academic staff. Marks at examinations will be on the West Point system, and the committees will report to the commandant of the school the results of the examinations. As the efficiency of the instruction can be much influenced by the instructors, they will keep themselves fully advised of the progress of the students; will give them at any time any needed aid, and, when the information on special subjects is difficult to obtain, should supplement the course by lectures. The instructors will meet their classes weekly and assign the lessons for the following week.

FIRST WINTER'S COURSE.

2. The course for engineer officers spending their first winter at the school will be: Electricity and torpedoes, nineteen weeks; surveying, two weeks. For officers of other arms of the service detailed for special instruction in the torpedo service: Electricity and torpedoes, twenty-one weeks.

ELECTRICITY.

3. Study of, in its application to torpedo warfare, arc and incandescent lighting and transmission of power, supplemented by extensive laboratory practice in the solution of the special problems involved. Text-books and books of reference, as follows: Abbot's Notes on Electricity; Ayrton's Practical Electricity; Thompson's Electricity and Magnetism; Maier's Arc and Glow Lamps; Swinburne's Practical Electrical Measurements; Kapp's Electrical Transmission of Energy; Part II of Professional Papers No. 23, Corps of Engineers, U. S. Army; Gray's Absolute Measurements, Volume II; Monroe and Jamieson's Pocket Book of Electrical Rules and Tables,

TORPEDOES.

4. Text-book: The Torpedo Manual. Practice will be had in making all the adjustments and tests required in planting and operating torpedoes, the operations on the water being simulated as far as practicable by special indoor appliances. Books of reference: Bucknill's Submarine Mines and Torpedoes as Applied to Harbor Defense; Scheidnagel's Treatise upon Defensive Submarine Mining.

5. Attendance at the electrical laboratory will be regulated by the instructor. Theoretical study will be done as far as practicable in quarters. All laboratory work will be done without the use of text-books or text-book diagrams. Officers may, however, use manuscript notes or diagrams prepared before going to the laboratory. Laboratory practice will be had from 9 a. m. to 12 m., and from 1 to 4 p. m. During the last two weeks of the course each engineer officer will prepare a plan (map and memoir) for the defense of such harbor as may be designated by the instructor, special attention being given to the torpedo defense and the batteries protecting the topedo lines.

SURVEYING.

6. (Last two weeks of course and preparatory to actual fieldwork.) Subjects: (1) Adjustment, use, and care of instruments; (2) topographical surveying with transit and stadia; (3) hydrographic surveying and gauging of rivers; (4) geodetic surveying. Text-book: Such parts as may be designated by the academic staff of Johnson's Theory and Practice of Surveying.

SECOND WINTER'S COURSE.

7. Civil engineering, five weeks; military engineering, seven weeks; photography, five weeks; torpedoes, four weeks.

CIVIL ENGINEERING.

8. (Five weeks.) Subjects: (1) improvement of nontidal rivers; (2) improvement of tidal rivers; (3) canals.

9. Text-books: Vernon Harcourt's Rivers and Canals; Schlichting's Improvement of Nontidal Rivers. Books of reference. (See third winter's course.)

MILITARY ENGINEERING.

10. (Seven weeks.) Subjects: (1) Modern guns, carriages, and projectiles; (2) steel, compound, wrought and cast iron armor; (3) modern ships of war and seacoast defenses; (4) modern fortifications and their attack and defense.

11. Text-books: Such parts of the following books as may be designated by the academic staff: Woolwich Text-book of Fortifications; Maguire's Attack and Defense of Coast Fortifications; Fortifications of To-day; Inglis's paper in Professional Papers, Royal Engineers, 1884, and a lecture on amored defense in Ordnance Notes, No. 181; Very's Development of Armor; Naval Intelligence Papers, June, 1886; Adams's Epezia Experiments, 1886; Baylay's Types of Modern Guns; The Protection of Heavy Guns for Coast Defense, Sir A. Clark; Abbot's Lectures on Seacoast Defense; Professional Papers, No. X, of U. S. Engineer School of Application.

12. Books of reference: Articles on fortification and gunnery, Encyclopœdia Britannica; Ordnance Notes, No. 135 and Appendix; Volume 9, Professional Papers, Royal Engineers; Report Board on Fortifications; Text-books on Gunnery, McKinlay; Naval Annual, 1887, Brassy.

MILITARY PHOTOGRAPHY.

13. (Five weeks.) Practice will be had in the following methods: Negatives by dry process; developers and intensifiers; silver printing and finishing and mounting of prints; map printing by the blue process and on bromide paper. Each officer to submit for examination two landscapes; negatives, silver and blue prints, two copies; negatives, silver and blue prints; negative of map, with three blue and three bromide prints. Text-books: Griffin's Notes on Photography; Von Sothen's The Development of the Latent Image on Gelatino-Bromide of Silver.

TORPEDOES.

14. (Four weeks.) One or more officers of the second and third winters' course will be detailed weekly to report to the instructor in torpedoes, as assistant for testing core joints and instructing enlisted men on the torpedo detail.

THIRD WINTER'S COURSE.

15. Civil engineering, 10 weeks; military engineering, 6 weeks; torpedoes, 5 weeks.

CIVIL ENGINEERING.

16. (Ten weeks.) Subjects: (1) Wave and current action, and improvement of harbors; (2) steam engines and pumps; (3) building superintendence; (4) preparation of project for or the history of the improvement of some designated river or harbor.

17. Text books, such parts of the following books as may be designated by the academic staff: Vernon Harcourt's Harbors and Docks; Edwards's Steam Engineers' Guide; Clark's Building Superintendence.

18. Books of reference: Rankine's Civil Engineering and Steam Engine, Bixby's Point de Grave; articles on hydro-mechanics and steam engine, in Encyclopædia Britannica; Cotterill's Applied Mechanics; Jameison on Steam Engine; Steam Boilers, Wilson; Modern Steam Engine, Rose; Canal and River Engineering, D. Stevenson; Construction of Harbors, T. Stevenson; Hydraulics of Great Rivers, Revy; Trautwine's Engineers' Pocket Book; Berg's Safe Building; Bullock's Architecture and Building; Billing's Ventilation and Heating.

MILITARY ENGINEERING.

19. (Six weeks.) Hamley's Operations of War, and preparation of project for the defense of such place as may be designated by the instructor.

TORPEDOES.

20. (Five weeks.) (See paragraph on torpedoes in second winter's course.)

COURSE FOR ENLISTED MEN.

INSTRUCTION OF ENLISTED MEN IN TORPEDOES.

21. Instruction will comprise telegraphing with the dial instrument, including the code for action, and practice in the Morse system of telegraphy; the duties of the loading room, and, so far as practicable, of the boat service as prescribed in the Torpedo Manual, comprising preparing the plugs of the buoyant and ground torpedoes; charging the mines; charging the cut-off boxes, three methods; jointing the cores; making turk's heads in the electrical cable; using the junction boxes; attaching a cable stop; splicing and knotting hemp rope; inserting thimble in wire mooring rope. They will also receive from the instructor in torpedoes, or his assistant, lectures respecting the fuses, explosives, torpedo material (except that of the operating room), voltaic batteries, simple electrical testing, and the use of the portable apparatus for the electrical ignition of mines.

The "unit" detail for this instruction will consist of 1 noncommissioned officer and 4 privates. Six such details will report for duty Monday morning, and will continue their instruction during fatigue hours until their work has been inspected and accepted by the officer in immediate charge. One or two of the unit details will probably finish their tasks by Tuesday evening, when other details may be made to commence work Wednesday morning. As soon as a man has had his work accepted, *i. e.*, has received a rating of "2.5," he will be excused from further attendance, and in case he has shown a commendable amount of skill and intelligence in his duties will be a candidate for such special privileges as it may be deemed expedient to give him. A soldier qualifying twice as "2.5" will be excused from further detail during the winter season.

Recruits on their first detail will be kept under instruction indefinitely until they have done each task at least twice and have received a rating of at least "2.0." They will then be placed on the same footing as old soldiers for further details.

The officer in immediate charge will be present in the loading rooms a large portion of each day, frequently inspecting the work of the several details. He will make it a special object to note the character of the instruction given by the noncommissioned officers who should know their duties well, and who should be held to a strict account for any defective work that their details may do. He will rate the men as they complete their tasks by a detailed examination of their finished work and a more or less detailed course of questioning. In determining a man's "mark" regard will be had to the degree of intelligence displayed as well as to the mechanical skill with which the work has been done. At the close of each week he will submit a "proficiency" report of the detail and state what verbal or other instruction was given during the week.

INSTRUCTION OF ENLISTED MEN IN PHOTOGRAPHY.

22. Two noncommissioned officers will be detailed each week for instruction in photography. Practice will be had in the following methods: Negatives by dry process; developers and intensifiers; silver printing, and finishing and mounting of prints; map printing by blue process and on bromide paper.

II. The following assignment of instructors is made:

Torpedoes: Capt. C. B. Sears, Corps of Engineers.

Military engineering: Capt. R. L. Hoxie, Corps of Engineers.

Civil engineering: Capt. William M. Black, Corps of Engineers.

Military photography: Second Lieut. Henry Jervey, Corps of Engineers, battalion quartermaster.

By order of Lieut. Col. King:

ROBERT MCGREGOR,
Second Lieutenant of Engineers, Post Adjutant.

APPENDIX B.—INSTRUCTION OF ENLISTED MEN IN MECHANICAL TRADES.

[Printed Orders, No. 35.]

UNITED STATES ENGINEER SCHOOL,
Post of Willets Point, New York Harbor, March 1, 1892.

1. Company commanders are requested to recommend to this office 4 company duty privates each, for instruction in mechanical trades. In making the recommendations the wishes of the men will be consulted as far as is practicable, and as far as they accord with the ideas of company commanders as to capacity and fitness.

2. The instruction of these men will be under the direction of Additional Second Lieut. John S. Sewell, Corps of Engineers, who will examine the men as to preliminary knowledge and the work for which they are qualified.

3. He will keep himself informed as to their progress and the assistance given them by the mechanics with whom they are employed, examine them, and give such theoretical instruction as they may need from time to time. For this purpose copies of the manuals used in the New York trade schools have been procured, and will be adapted as far as practicable to the needs of this school.

4. As fast as the men become sufficiently skillful in the trades upon which they may be employed the instructor will report the fact, when they will be replaced by others from the same companies, and will be enrolled in order of merit as mechanics, upon the list from which the mechanics are drawn for extra and special duty.

5. The men under instruction as above will report for duty, as directed by the instructor, during fatigue hours each day, and will be on the same footing as regards exemption from other duty as the men when under instruction at the post school.

By order of Lieut. Col. King:

ROBERT MCGREGOR,
Second Lieutenant of Engineers, Post Adjutant.

APPENDIX C.—PROGRAMME OF STUDY AND INSTRUCTION FOR SUMMER SEASON.

[Printed Orders No. 74.]

UNITED STATES ENGINEER SCHOOL,
Post of Willets Point, New York Harbor, May 2, 1892.

The following programme of study and instruction for the ensuing summer season, to commence May 9 and end November 14, 1892 (twenty-eight weeks), having been recommended by the academic staff and approved by the Chief of Engineers, will be carried into effect:

A roster of the student officers will be kept by the post adjutant, who will make weekly details for the various duties so that they shall not conflict.

I.—MILITARY ENGINEERING.

1. Instruction by the company officers in the nomenclature, dimensions, and construction of modern siege batteries and saps.

2. A full course of trestle and pontoon bridge drill.

3. Instruction in building spar bridges.

4. Instruction in military mining.

5. Military map-making. Each lieutenant of Engineers, who has not already done so, and such noncommissioned officers and privates as may be selected from each company will make satisfactory foot reconnoissances about 4 miles long, in the vicinity of the post, the maps thereof to be submitted by company commanders to post headquarters on or before November 14, 1892.

II.—TORPEDO DRILLS.

6. After receiving such preliminary practice as may be necessary to acquaint them with the practical details of preparing and planting a torpedo, the officers of the torpedo class will be divided into details of at least two officers each, for the purpose of taking charge of the preparation and planting of a grand group of torpedoes, under the direction of the instructor in torpedoes, assisted by one engineer officer of the second or third winter's class.

7. The senior officer will be in general charge, and will keep a daily journal of operations, noting particularly any difficulties encountered and any suggestions that may occur to him, looking to the avoidance of similar difficulties in the future.

8. The officers will frequently interchange duties so that each one shall have some experience in each part of the drill.

9. The electric light will be set up and operated.

10. The grand group being completed and the search light in position, the post commander will order an exhibition drill illustrating the operations of the torpedo defense against an attempted passage of the mine field by an enemy's vessel under cover of night.

11. The group will then be taken up by the same detail and the parts dismantled, cleaned, and conveniently grouped for the inspection of the instructor.

12. The detail will be instructed and exercised in automatic and judgment firing drills at such times as may be most convenient before the final exhibition drill.

13. The detail of enlisted men for each grand group drill will consist of 3 noncommissioned officers and about 12 privates.

14. The hours of work will be from 7 to 11:30 a. m., and from 1 to 4:30 p. m. In bad weather, when no work is done and the men are in barracks, the latter will attend the same company duties and roll calls as daily duty men.

15. Weekly reports of progress will be rendered by the senior officer of the detail, and at the conclusion of the work each officer will submit a report of the work done by him, mentioning difficulties encountered and any suggestions he may desire to make.

16. A detailed record will be kept of what each man does with the view of tracing out the author of defective work and determining the degree of proficiency developed by individual members of the detail. An account of the character of work done by each man will be submitted by the senior officer with his final report.

17. Occasionally, if practicable, loaded mines will be planted and fired as in actual service, height of jet, effect on neighboring mines and other phenomena being carefully observed and recorded.

18. At such times as will not interfere with the drills above mentioned, the officers of the class will make practical experiments in calibrating commercial ammeters and voltmeters, testing efficiency of dynamos and motors.

III.—CIVIL ENGINEERING.

19. A topographical survey of about one-half square mile of ground by each officer of the first summer's class. Time allotted, 5 weeks.

20. A hydrographic survey of about one-quarter square mile by each officer of the second summer's class. Time allotted, 4 weeks.

21. Practical problems in civil engineering by the second summer's class. Time allotted, 7 weeks.

22. While engaged in the field work in topographical and hydrographic surveys the officers will be assisted by details of enlisted men and will be excused from all other duties.

IV.—FIELD ASTRONOMY.

23. All the lieutenants of engineers who have not already completed the course and been excused from further observations, will constitute the observers, being called upon by the officer in charge as wanted.

24. The following system will govern the observations at the observatory. The course covers two seasons—the first including theory and use of astronomical instruments, and sextant, transit, and telescope work with the instruments in the east wing and on the outer pier; and the second including sextant work, and transit and zenith telescope work, and with chronograph with the new combined instruments in the west wing.

25. Officers wishing to use the instruments for special observations or practice, must apply for authority to do so, and are not permitted to handle any instruments unless specifically assigned to them by the instructor.

26. In case of damage to instruments or apparatus, it will be promptly reported to the instructor for the action of a board of survey.

27. The following will be the ordinary routine of observations with the several instruments, after reasonable proficiency has been attained by prelimiary practice.

SEXTANT.

After becoming skillful in the use of this instrument upon the sun, observers will deduce at least one satisfactory latitude by observing a north and a south star, using the time deduced from an east and a west star—each based on ten altitudes taken on the same night. These observations for latitude and time must be made at the observatory. The observer may get "time" from an assistant, using a portable chronometer and will determine, by comparison, the error of standard chronometer at observatory.

CHRONOGRAPH.

Daily determination, by time signal from Washington, D. C., of error and rate of astronomical clock, by the officer of the day.

TRANSIT.

A satisfactory set of time observations will be taken by each officer on two nights, successive if possible, determining satisfactorily the error of siderial clock. The junior class will employ the eye and ear method; the senior class will use the chronograph. The observer will not receive any assistance.

ZENITH TELESCOPE.

Observers will first determine the level correction by daylight, using a distant terrestrial object, or at night using a slow circumpolar star. They will then find the value of a turn of the micrometer by observing Polaris at elongation. Lastly, they will observe for latitude, until they have obtained a satisfactory determination.

28 Suitable blank forms will be provided, both for observations and computations; and all problems must be submitted, complete in every detail, upon these forms. The original records, after inspection by the commanding officer, will be returned to the officers as their personal property.

29. Hours of attendance at the observatory will be, for both classes, daily except Saturday and Sunday, from 8 to 10 a. m. from 2 to 4 p. m. and from 8 to 10 p. m. Evening hours will be extended when it is necessary to secure complete sets of observations.

V.—MILITARY PHOTOGRAPHY.

30. The officers' laboratory will be opened daily from 1:30 p. m. to 4 p. m.

31. The building, apparatus, chemicals, etc., will be under the charge of the battalion quartermaster, whose duty it is to furnish any desired assistance, and who will be held responsible for the judicious use of the property.

32. Officers are invited to avail themselves of the advantages of the laboratory, making such arrangements with the officer in charge as shall insure no confusion in his official duties, or in those of the men under his instruction.

33. The instruction of enlisted men will be restricted to a weekly detail of one noncommissioned officer from each company.

34. The battalion quartermaster will submit to this office weekly reports showing the nature of the instruction given, the results attained and the progress made.

By order of Lieut. Col. King:

ROBERT MCGREGOR,
Second Lieutenant of Engineers, Post Adjutant.

APPENDIX D.—TESTS OF STONE.

REPORTS OF LIEUTENANT A. M. D'ARMIT, CORPS OF ENGINEERS.

1.

WILLETS POINT, N. Y., *January 16, 1892.*

SIR: In compliance with your request I have the honor to submit the following report of the tests of two specimens of sandstone forwarded by Capt. Fiebeger, Corps of Engineers, for the purpose:

The specimens were cubes, 2 inches on the edge, and very accurately cut. The bed of the stone was not marked, however, and this is a serious oversight in preparing stones for testing. By mere chance I managed to get the cubes properly placed in the machine, and they were broken, as they should be, "on bed." Sketches of the fractures are not given, as the stones broke into small fragments with a loud explosion when the breaking stress was reached.

In structure and general appearance when crushed this sandstone compares very favorably with the best specimens that I have tested. For definite and reliable results, however, not less than four samples from a given quarry should be tested, and they should be carefully sawed into cubes, as the blows of a hammer are decidedly injurious to small specimens.

Very respectfully, your obedient servant,

A. M. D'ARMIT,
Second Lieutenant of Engineers.

Col. W. R. KING.

Table of results.

Number.	Description.	Strength.	Pounds per square inch.	Specific gravity.	Weight per cubic foot.
		Pounds.			*Pounds.*
1	Purplish	38, 000	9, 500	2. 55	159. 1
2	do	30, 000	7, 500	2. 55	159. 1

Mean strength, 8,500 pounds per square inch.
Ratio of absorption, .016.

2.

WILLETS POINT, N. Y., *May 16, 1892.*

COLONEL: In compliance with the request contained in the inclosed letter, I have the honor to submit herewith the results of tests made in the usual manner. The tabulated results explain themselves, and seem to call for no comment. The crushing surfaces were pasteboard.

Very respectfully, your obedient servant,

A. M. D'ARMIT,
Second Lieutenant of Engineers.

Col. W. R. KING.

Letter.	Description.	Kind.	How crushed	Strength of specimen.	Strength per square inch.	Specific gravity.	Rates of absorption.
				Pounds.	*Pounds.*		
A	Davis' Quarry, first ledge, middle.	Gray, slightly green, rather coarse.	Bed...	30,000	7,500	2.23	0.058
B	Davis' Quarry, second ledge, middle.	Lighter and considerably finer texture.	..do ...	45,000	11,250	2.40	.053
C	Davis' Quarry, third ledge, top.	Whiter, no green, slightly coarser than B.	..do(?).	21,000	5,250	2.29	.05
D	Davis' Quarry, third ledge, middle.	Greenish, a little finer than A.	..do ...	38,500	9,625	2.35	.046
E	Davis' Quarry, bottom.	Coarse, gray, stratification irregular.	..do(?).	30,000	7,500	2.42	.036
F	Wright's Quarry, from bowlders in front of ledge.	Smooth, even, light, rather fine texture.	..do ...	19,000	4,750	2.30	.047
G	......do	......do	..do ...	20,000	5,000	2.31	.048
H	Plymouth Quarry, top of hill, down-stream ledge.	Whitish, rather coarse free grains of quartz.	..do ...	25,000	6,250	2.42	.032
I	......do	......do	..do ...	32,000	8,000	2.38	.033
J	Elk Quarry, quarrier ..	Slaty, greasy, fast, fine texture, very homogeneous.	..do ...	54,000	13,500	2.44	.032
K	Superior freestone, Rowan County, Ky.	Very smooth and even	..do ...	55,000	13,750	2.315	.044

APPENDIX E.—TESTS OF WIRE ROPE.

REPORT OF LIEUTENANT A. M. D'ARMIT, CORPS OF ENGINEERS.

WILLETS POINT, *February 10, 1892.*

COLONEL: In compliance with your instructions, I have the honor to submit herewith the following report of the tests of wire rope made by me to-day:

The rope was of galvanized steel wire of the ordinary form of cross-section adopted for the mooring rope in our torpedo system. Three samples, 3 feet in length each, were prepared, although but two were tested. These broke at 26,000 and 25,000 pounds, respectively, the breaking in each case being just over the top of the thimble, where the outer strand parted. I am inclined to think the breaking was due to the excess of stress brought on these strands by the sharp curvature of the thimble. This view is further supported by the fact that between marks on the rope 14 inches apart the yielding was less than one-sixteenth of an inch, showing that the rope as a whole had been strained to nothing like its elastic limit. The holding of the new form of shackle was particularly satisfactory, and had two of these been obtainable the rope would doubtless have showed a very high breaking strength.

Very respectfully, your obedient servant,

A. M. D'ARMIT,
Second Lieutenant of Engineers.

Lieut. Col. W. R. KING,
Corps of Engineers.

MEMORANDUM.—The same piece of rope was afterwards, February 19, 1892, fitted with another of the new shackles and stood a pull of 33,000 pounds, or about twice the breaking strength of the ordinary iron mooring rope of the same size.

W. R. K.

RIVERS AND HARBORS, ETC.

APPENDIX A.

IMPROVEMENT OF RIVERS AND HARBORS IN MAINE AND NEW HAMPSHIRE.

REPORT OF LIEUTENANT-COLONEL PETER C. HAINS, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. St. Croix River, Maine.
2. Lubec Channel, Maine.
3. Mooseabec Bar, Maine.
4. Pleasant River, Maine.
5. Narraguagus River, Maine.
6. Breakwater from Mount Desert to Porcupine Island, Maine.
7. Bagaduce River, Maine.
8. Penobscot River, Maine.
9. Belfast Harbor, Maine.
10. Camden Harbor, Maine.
11. Rockport Harbor, Maine.
12. Rockland Harbor, Maine.
13. Kennebec River, Maine.
14. Harraseeket River, Maine.
15. Portland Harbor, Maine.
16. Channel in Back Cove, Portland, Maine.
17. Saco River, Maine.
18. Kennebunk River, Maine.
19. York Harbor, Maine.
20. Portsmouth Harbor, New Hampshire.
21. Bellamy River, New Hampshire.
22. Cocheco River, New Hampshire.
23. Harbor of refuge at Little Harbor, New Hampshire.
24. Removing sunken vessels or craft obstructing or endangering navigation.

EXAMINATIONS AND SURVEYS.

25. Penobscot River, Maine.
26. Kennebec River, Maine, from Waterville to steamboat wharf at Augusta.

UNITED STATES ENGINEER OFFICE,
Portland, Me., July 1, 1892.

GENERAL: I have the honor to forward herewith my annual report for the fiscal year 1892, on harbor and river works in my charge.

Very respecfully, your obedient servant,

PETER C. HAINS,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

A 1.

IMPROVEMENT OF ST. CROIX RIVER, MAINE.

The river and harbor act of August 11, 1888, provided for an examination and survey of the St. Croix River, the reports on which were published in Annual Report of the Chief of Engineers for 1890 (page 463.)

When the survey was made the available depth over the shoals at mean low water was from 6.5 to 9.5 feet, and at the upper steamboat wharf at Calais it was but 1.5 feet. The channel was also narrow.

The improvement proposed was a channel 12 feet deep at mean low water, and generally 200 feet wide (but narrowed to 150 and 100 feet in the upper part of the harbor to avoid ledge) up to the upper steamboat wharf, immediately below the bridge, which marks the head of navigation. Such improvement would enable steamboats to land at the upper wharf at all stages of the tide, and would also permit the larger vessels engaged in the lumber trade to receive their full cargoes at the wharves, instead of dropping down the river nearly 4 miles after being partially loaded, and completing their cargoes from material rafted down to them. The object was to be accomplished by dredging and by the construction of a small jetty and training wall. The work proposed extends over about 4 miles of the river. The difference between high and low tides is about 20 feet. The estimated cost of the improvement was $280,000.

An examination of the river was made in 1867 by the officer in charge of the district, and subsequently, that is, between 1866 and 1874, appropriations were made for the improvement amounting to $35,000 in the aggregate, but each appropriation provided that the Dominion Government of Canada should expend an equal amount on the improvement. In 1873 the Dominion Government of Canada appropriated $25,000 for improving the river, that being the amount that had been appropriated up to that time by the United States. A conference was held by the engineer of the district with an agent of the Dominion Government, and a plan of improvement was agreed upon. The obstructions consisted of slabs, sawdust, and other mill waste; but before allowing the expenditure of the money appropriated by the Government of Canada, the minister of public works required that some guaranty should be given that the further deposit of this refuse in the river should be discontinued. As there did not seem to be any law at the time in existence by which the deposit could be prevented, the money that had been appropriated was not expended on that improvement, but in 1870 Congress authorized the appropriation made for the St. Croix to be expended on the Lubec Channel, which was done.

The act approved September 19, 1890, appropriated $35,000 again for the improvement of the St. Croix, "but upon condition that the Government of the Dominion of Canada shall expend a like sum in the improvement of said river." On account of the proviso contained in the act no expenditures have been made, and no work has been done under the appropriation of September 19, 1890, pending action by the Dominion Government.

Money statement.

July 1, 1891, balance unexpended	$35,000.00
July 1, 1892, balance unexpended	35,000.00
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	245,000.00

COMMERCIAL STATISTICS.

Receipts and shipments during calendar year 1891.

	Tons.		Tons.
Bricks	500	Lime	5,000
Cement	1,000	Lumber	190,000
Coal	30,000	Plaster	15,000
Cotton	5,730	Plaster rock	17,000
Farm produce	10,000	Miscellaneous	100,000
Grain	10,000		
Flour	8,000	Total	393,230
Iron	1,000		

Number of vessels arriving and departing during calendar year 1891 (estimated).

Vessels of about 150 tons each, coastwise lumber trade	657
Vessels in the plaster trade	250
Sloops and lighters	400
Steamers and foreign cargoes	400
Total	1,707

A 2.

IMPROVEMENT OF LUBEC CHANNEL, MAINE.

This channel lies between the eastern extremity of the State of Maine and Campobello Island, Dominion of Canada. It has a length of between 2 and 3 miles, connecting the waters of Quoddy Roads, below, with those of Friar Roads, above. The least width between low-water contours is about 400 feet and between high-water contours about 800 feet. The mean range of tides is about 17 feet. It affords a sheltered route, and the most direct one, for vessels to and from Eastport and the St. Croix River, besides being the only passage not in waters belonging to the province of New Brunswick. The channel is also important in connection with Quoddy Roads as a harbor of refuge. During such storms as make anchorage in the latter unsafe, vessels may escape through Lubec Channel into sheltered waters above.

The following appropriations have been made:

Act of—	
March 3, 1879	$44,000
June 14, 1880	20,000
March 3, 1881	45,000
August 2, 1882	20,000
July 5, 1884	10,000
August 5, 1886	10,000
August 11, 1888	20,000
	169,000

Previous to 1879 the mean low-water depth in the channel did not exceed 5 feet, and at extreme low water the depth did not exceed 2 feet.

The project adopted in 1879 provided for a channel 200 feet wide and 12 feet deep at mean low tide, which would be equivalent to 9 feet at low spring tides. The estimated cost was $48,000. This estimate was based on prices below what the work was subsequently done for. This project was revised in 1880, the estimated cost being increased to $130,000. The project was again, in 1884, amended so as to provide a channel 275 feet wide and 300 feet wide in the bends, the depth of 12 feet being retained, and the estimated cost of the entire project being increased to $171,500.

At the close of the fiscal year ending June 30, 1891, there had been expended the sum of $168,929.42, completing the project.

The river and harbor act approved September 19, 1890, contained an order for an examination of Lubec Channel, the report on which was published in the Annual Report of the Chief of Engineers for 1891 (page 616). A new project is therein submitted for a channel having a least width of 500 feet and a depth of 12 feet at mean low water, the cost, in addition to the amount already expended, being estimated at $231,000.

No work was done during the year ending June 30, 1892. The expenditures during the past year were $25, and the total expenditures since 1879 amount to $168,954.42.

There is a light-house on Campobello Island, at the narrows, opposite Lubec.
Lubec is in the collection district of Passamaquoddy.

Money statement.

July 1, 1891, balance unexpended	$70.58
June 30, 1892, amount expended during fiscal year	25.00
July 1, 1892, balance unexpended	45.58

COMMERCIAL STATISTICS.

The commerce of Lubec Channel not being local in its character, it is impracticable to obtain statements of the tonnage. The keeper of the Lubec Channel Light-Station has estimated that not less than 1,200 sailing vessels passed the station during 1891, besides a considerable number of steamers.

A 3.

IMPROVEMENT OF MOOSABEC BAR, MAINE.

Moosabec Bar is in the eastern part of Moosabec Reach, near Jonesport, Me. The bar was the only obstruction to navigation in the reach, which was used by hundreds of vessels. At mean low stages the depth was less than 6 feet, and at extreme low tides the depth was less than 4 feet. In fogs, which are prevalent on this part of the coast, navigation was rendered dangerous by the tortuous route that had to be taken to keep clear of the ledges.

A survey, ordered in the river and harbor act of March 3, 1879, was made by Col. George Thom, and a project of improvement suggested, the estimated cost of which was $28,000. The project contemplated the excavation of a straight channel running nearly east and west, 200 feet wide and 14 feet deep at mean low tide, and the removal of a sunken ledge near Steamboat Buoy to 15 feet. In 1881, after an appropriation had been made, the project was adopted, but the estimated cost was increased to $35,000. Subsequently, in 1882, the project was amended, as it was found that the quantity of dredging had to be increased, so that the cost as revised was estimated at $40,000. Work on that project was continued until 1888, when it was amended so as to provide for a channel 300 feet wide and 14 feet deep, the removal of certain ledges near the westerly end of the dredged channel to a depth of 16 feet, and the construction of a small breakwater and beacon to check cross currents. The estimated cost of the additional work was $110,000, and that for the entire improvement as enlarged $150,000. This latter project is the one now in process of execution.

The following appropriations have been made:

Act of—	
March 3, 1881	$10,000
August 2, 1882	10,000
July 5, 1884	10,000
August 5, 1886	10,000
August 11, 1888	15,000
September 19, 1890	15,000
	70,000

The expenditures to June 30, 1891, were $53,888.29.

At the latter date the 300-foot channel had been completed to the full projected width and depth, the construction of the breakwater had been commenced, and a small quantity of ledge had been removed.

The expenditures during the past year amount to $6,530.48, which was applied to the completion of the small breakwater included in the project. The work remaining to be done consists of the removal of ledges obstructing the channel at its west end.

The improvement is in the collection district of Machias, Me. The nearest lighthouse is Moose Peak. The nearest port of entry is Machias, Me.

Money statement.

July 1, 1891, balance unexpended	$16,111.71
June 30, 1892, amount expended during fiscal year	6,530.48
July 1, 1892, balance unexpended	9,581.23
Amount appropriated by act approved July 13, 1892	15,000.00
Amount available for fiscal year ending June 30, 1893	24,581.23
Amount (estimated) required for completion of existing project	65,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

The benefits derived from the improvement are not local, the thoroughfare being used by coastwise vessels both as a harbor of refuge and as a sheltered route in bad weather. It is, therefore, impracticable to obtain accurate commercial statistics. The number of vessels passing through the reach annually has been estimated to be as great as 25,000.

A 4.

IMPROVEMENT OF PLEASANT RIVER, MAINE.

Pleasant River, Maine, is a small stream emptying into Pleasant Bay, about 30 miles to the eastward of Mount Desert Island and about 5 miles to the westward of the western entrance of Moosabec Reach.

Originally the channel above Addison Point was obstructed by bowlders, while below navigation was rendered dangerous by two rocks and a shoal or ledge of gravel, in mid-river.

The act of September 19, 1890, appropriated $3,500 for completing the improvement. The project was to mark the rocks by a beacon, and the shoal by a spindle, the remainder of the appropriation to be expended in removing bowlders from the channel above Addison Point, the work to be done by hired labor and purchase of materials in open market.

The work was commenced in June, 1891, and completed during the following August. A stone beacon was built on "Channel Rocks," and an iron spindle, the top of which is about 25½ feet above mean low water, was established on the shoal known as "Coffins Rocks." Seventy large bowlders, weighing in the aggregate about 55½ tons, besides about 100 smaller ones, were removed from the river above Addison Point.

The entire appropriation of $3,500 was expended during the fiscal year ending June 30, 1892, completing the improvement.

Money statement.

July 1, 1891, balance unexpended	$3,500.00
June 30, 1892, amount expended during fiscal year	3,500.00

A 5.

IMPROVEMENT OF NARRAGUAGUS RIVER, MAINE.

The part of the river comprised in the project now in process of execution for improvement is at the mouth of the river proper and at the head of Narraguagus Bay below the village of Millbridge. The river is navigable for small vessels as far up as Cherryfield, 5 miles above Millbridge.

Before the improvement was commenced the depth over the bar at the mouth of the river was less than 6 feet at mean low water and less than 4 feet at extreme low water.

From Millbridge to Cherryfield, the head of navigation, a distance of about 5 miles, the navigation was obstructed by bowlders, ledges, and bars.

The following appropriations have been made:

For improvement above Millbridge:	
Act of March 3, 1871	$12,000
Act of June 10, 1872	10,000
For improvement of river from its mouth to Millbridge:	
Act of August 5, 1886	10,000
Act of August 11, 1888	10,000
Act of September 19, 1890	7,500
	49,500

The original project provided only for the betterment of navigation above Millbridge by the removal of obstructions, such as mill waste, sunken bowlders, and projecting ledges and the construction of an iron spindle on Half Tide Rock. This work was completed in 1874, the amount expended being $22,000 (the first two appropriations). The resulting improvement is said to have been of great benefit to navigation.

A second project for the improvement of the river below Millbridge was submitted in 1880, but no appropriation was made until 1886. The project for the improvement of this part of the river has for its object the dredging of a channel not less than 200 feet wide from deep water in Narraguagus Bay to the place known as "Deep Hole," where vessels anchor in bad weather, the depth to be 11 feet at mean low water as far up as Long Point, and from thence to "Deep Hole" to be 9 feet.

The mean range of the tides is 11.2 feet.

The estimated cost of this improvement was $50,000.

The expenditures under the last project, up to June 30, 1891, amounted to $22,341.57. At that date there had been dredged an 11-foot channel from the deep water in the bay in toward the new steamboat wharf, 55 to 90 feet wide, with a space in front of the wharf 300 feet wide. From the new steamboat wharf to the old one near Long Point the channel was 100 feet wide, with a turning basin in front of the old wharf 300 feet wide.

The expenditures during the fiscal year ending June 30, 1892, amounted to $5,121.85, chiefly for liabilities incurred during the previous fiscal year. The contract for dredging, which was in progress at the date of the last Annual Report, was completed July 11, 1891, and no work has been done since, so that practically no work has been in progress during the year just ended. The operations in July, 1891, resulted in obtaining a channel width of 90 feet from the new steamboat wharf to the deep water of the bay.

The improvement is in the collection district of Machias. The nearest port of entry is Machias. The nearest light-house is Narraguagus Light-house on Pond Island.

Money statement.

July 1, 1891, balance unexpended	$5, 158. 43
June 30, 1892, amount expended during fiscal year	5, 121. 85
July 1, 1892, balance unexpended	36. 58
Amount appropriated by act approved July 13, 1892	7, 500. 00
Amount available for fiscal year ending June 30, 1893	7, 536. 58
Amount (estimated) required for completion of existing project	15, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1894	15, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Receipts and shipments.

	1890.	1891.
	Tons.	*Tons.*
Coal		1, 200
Fish		782
Hides	450	275
Iron		200
Lumber	41, 500	38, 077
Leather	300	400
Salt		800
Stone	2, 000	2, 500
Miscellaneous	22, 250	4, 725
Total	66, 500	48, 959

Number of vessels arriving and departing.

Year.	Steamers.	Sailing vessels.
1890		250
1891	144	200

The total tonnage of steamers during 1891 is stated to be 172,800; average draft of water, 8 feet. The total tonnage of sailing vessels during 1891 is stated to be 28,000; average draft of water, 9 feet.

A 6.

BREAKWATER FROM MOUNT DESERT TO PORCUPINE ISLAND, MAINE.

The anchorage in front of the town of Bar Harbor, Mount Desert Island, Maine, as well as the wharves at which steamers make their landings, is exposed to the seas from southerly and southeasterly directions. In southerly gales the anchorage is insecure in the harbor proper, and the landing of passengers and freight at the wharves is said to be difficult at such times. The number of people that visit Bar Harbor in the summer is large, but the amount of freight delivered and shipped is comparatively small. The anchorage is used chiefly by yachts. There are neither factories nor quarries on this part of the island, and the trade is chiefly in supplies of all kinds for summer visitors.

The original project was the construction of a riprap breakwater from the westerly corner of Round Porcupine Island to Dry Ledge, and thence, in a direct line, to a point near the shore of Mount Desert Island. In December, 1890, the project was amended so as to slightly change the direction of the part of the breakwater west of Dry Ledge, so that the westerly end would be somewhat farther to the southward. Under the above modification the proposed line for the main part of the work is, from Dry Ledge in a southwesterly direction to within about 400 feet of Mount Desert Island at a point south of the small cove known as Cromwell Harbor. The breakwater is to be built to the level of high water, that part from Porcupine Island to Dry Ledge to be 30 feet wide on top, with inner slope of 1 on 1 and an outer slope of 1 on 1½; that part between Dry Ledge and Mount Desert Island to be 20 feet wide on top, with both inner and outer slopes of 1 on 1. The total projected length of the breakwater is about 2,800 feet.

The estimate of the cost of the work is $806,000.

The following appropriations have been made:

By act of August 11, 1888	$50,000
By act of September 19, 1890	50,000

The expenditures to June 30, 1891, amounted to $19,144.53. Up to the latter date operations had been confined to that part of the work between Porcupine Island and Dry Ledge, and 17,520 tons of stone had been placed in position—rather more than one-fourth of the entire quantity (66,000 tons) estimated for that portion of the breakwater. The work had not reached a stage to be of much benefit.

The expenditures during the last fiscal year were $15,060.84, making the total expenditures under the project $34,205.37. At the date of the last Annual Report work was in progress on the part of the breakwater between Porcupine Island and Dry Ledge, under contract with Thomas Rhys Smith. About the middle of November, 1891, after delivering 19,080 tons of stone, Mr. Smith suspended operations. Subsequently, in March, 1892, the contract was annulled on the ground that it had been assigned. At the close of the fiscal year 1892 the entire quantity of stone placed in the work amounted to 30,473 tons, all of which had been deposited in that part between Porcupine Island and Dry Ledge. At the latter date the condition of the work was as follows:

About 385 linear feet of breakwater had been built up to high-water level and to the width of 20 feet on top, with slopes of 45 degrees on each face; about 80 feet more had been raised to high-water level, but not to the full width, and about 130 feet more was about 7 feet above low water.

During June, 1892, a contract was made with George M. Neelon, of Greens Landing, Me., for completing that part of the breakwater between Porcupine Island and Dry Ledge, and one with William S. White, of Rockland, Me., for work on that part between Dry Ledge and Mount Desert Island, operations in both cases to be commenced by July 1, 1892.

Bar Harbor is in the collection district of Frenchman Bay. The nearest port of entry is Ellsworth. The nearest light-house is on Egg Rock, 3½ miles distant.

Money statement.

July 1, 1891, balance unexpended		$80,855.47
June 30, 1892, amount expended during fiscal year		15,060.84
July 1, 1892, balance unexpended		65,794.63
July 1, 1892, outstanding liabilities	$50.00	
July 1, 1892, amount covered by uncompleted contracts	64,585.00	
		64,635.00
July 1, 1892, balance available		1,159.63
Amount appropriated by act approved July 13, 1892		50,000.00
Amount available for fiscal year ending June 30, 1893		51,159.63
Amount (estimated) required for completion of existing project		656,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for construction of breakwater from Mount Desert to Porcupine Island, Maine, May 14, 1892.

No.	Name and address of bidder.	First.		Second.	
		Between Porcupine Island and Dry Ledge, 11,000 tons.		West of Dry Ledge, 50,000 tons.	
		Price per ton.	Amount.	Price per ton.	Amount.
1	William S. White, Rockland, Me	$1.35	$14,850.00	$1.02	$51,000.00
2	George Mortimer Neelon, Greens Landing, Me	1.23½	13,585.00	1.08½	54,250.00
3	John F. Hamilton, Portland, Me	*1.29	14,190.00	1.13	56,500.00

* Conditional on acceptance of bid for part west of Dry Ledge.

Contract made with William S. White, June 1, 1892, for second part.
Contract made with George Mortimer Neelon, June 8, 1892, for first part.

Abstract of contracts for construction of breakwater from Mount Desert to Porcupine Island, Maine, in force during the fiscal year ending June 30, 1892.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price per ton for stone.
*1	T. Rhys. Smith, New York, N. Y.	Oct. 18, 1890	Placing stone in breakwater	$1.23½
2	William S. White, Rockland, Me.	June 1, 1892	Breakwater west of Dry Ledge	1.02
3	George Mortimer Neelon, Greens Landing, Me.	June 8, 1892	Breakwater between Porcupine Island and Dry Ledge.	1.23½

* Contract annulled.

COMMERCIAL STATSITICS.

The tonnage for Bar Harbor is reported to be practically the same as that stated for the previous year.

During the summer season there are steamers from Boston and Bangor that make daily trips. The Maine Central Railroad steamer makes three trips per day from the Mount Desert Ferry, connecting with through trains. There has been a line direct from Boston to Bar Harbor from July 1 to September 1. There are a number of small steamers that ply between Bar Harbor and adjacent places of resort. After the season closes the Bangor boats make two trips per week until the Penobscot River is closed by ice. The railroad boat runs all the year round, and the company will this season put on a new steamer from Portland to Machiasport, touching at Bar Harbor each way.

Nearly all the freight comes to Bar Harbor by the Maine Central Railroad via the Mount Desert Ferry.

The amount of tonnage owned in sailing craft above 20 tons is small.

In past years there have been numbers of small craft coasting between Bar Harbor, Ellsworth, and Bangor, with lumber, bricks, etc., for cottages for nonresidents. There has not been so much carried this last year as formerly.

A 7.

IMPROVEMENT OF BAGADUCE RIVER, MAINE.

When the project for improving this locality was adopted the channel near South Penobscot was crooked and obstructed by ledges of rock, and the least depth at low tide did not exceed 2 feet. The portion of the channel covered by the project for improvement is in the southern part of Northern Bay, on the easterly side of the Penobscot Bay.

The approved project is to obtain by dredging and rock excavation, a channel 100 feet wide, and 6 feet deep at low tide, from Bridges Point to Bowdens Wharf, South Penobscot, a distance of about 4,000 feet, the cost being estimated at $45,000.

It was also intended to remove a small quantity of rock obstructing the southern channel at Johnson Narrows, at an estimated cost of $1,875.

The mean range of tides is about 9.5 feet.

The following appropriations have been made:

By act of August 11, 1888	$3,000
By act of September 19, 1890	4,000
	7,000

The expenditures to the close of the fiscal year ending June 30, 1891, amounted to $100, which were for preparation of plans, etc. No work had been done.

The first appropriation, $3,000, was too small to be judiciously expended. Enough rock excavation to be of any practical benefit could not be accomplished with that amount, and the situation was such that without the removal of rock there was no good to be accomplished by dredging. It was, therefore, considered advisable to await additional appropriations.

There were no expenditures during the fiscal year ending June 30, 1892, and no work was done.

The improvement is in the collection district of Castine. The nearest port of entry is Castine, at the mouth of the river. The nearest light-house is at Dice Head.

Money statement.

June 1, 1891, balance unexpended	$6,900.00
July 1, 1892, balance unexpended	6,900.00
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	11,900.00
Amount (estimated) required for completion of existing project	34,875.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

Receipts and shipments during the calendar year 1891.

	Tons.		Tons.
Bricks	6,000	Hay	100
Coal	2,200	Ice	150
Cotton	150	Lumber	2,800
Farm produce	150	Lime, cement, etc	300
Fish, oysters, etc	150	Wood	6,000
Grain	8,000		
General merchandise	15,300	Total	41,300

Number of vessels arriving and departing during calendar year 1891.

Vessels of 200 tons to 400 tons each	200
Vessels of 5 tons to 100 tons each	600
Steamers of 1,000 tons to 1,500 tons each	400
Steamers of 50 tons to 200 tons each	800
Barges and flatboats	75
Total	2,075

A 8.

IMPROVEMENT OF PENOBSCOT RIVER, MAINE.

A survey of the Penobscot River was made in 1867 under the provisions of the act of Congress approved June 23, 1866. The navigation at that time was obstructed by rocks, ledges, and mill waste, giving at mean low tide only about 8 feet of water and a narrow, tortuous, and uncertain channel. At Bangor the depth was only about 6 feet at lowest stages, while numerous rocks and ledges made navigation dangerous. Col. Thom, under whose direction the survey was made, submitted an estimate for two projects of improvement, one giving a channel 150 feet wide, and 12 feet deep at low tide, up as far as Bangor, at an estimated cost of $125,000, and another with a depth of 18 feet at low tide, at an estimated cost of $665,000.

The improvement of navigation was not undertaken, however, until 1870, when the first appropriation was made under the river and harbor act of that year. Work on the 12-foot project was then systematically undertaken and was continued until 1880, under the several appropriations made by Congress. The original project was amended several times during this period. This was rendered necessary by the discovery of shoals where before they were not known to exist, and by work being ordered by Congress which was not included in the original estimates. The project was finally completed in 1880. The expenditures up to that time amounted to $198,000, and had resulted in straightening, deepening, and widening the channel through the several shoals and bars at Bangor and for a distance of about 3½ miles downstream, giving it a width of 200 feet and a depth of not less than 11 feet at low water in the lowest stages, or 14 feet at mean low stages; also in breaking up and removing all the sunken ledges and bowlders in the harbor of Bangor, outside the main channel, down to the level of the general bed of the river, including Independence Rock, Gullivers Rock, ledge near the steamboat wharf, and those near Doles Wharf, Greens Pier Ledge, and a ledge outside of it, the ledges and bowlders in front of the wharves at High Head, and also the removal of the shoal at Bucksport known as the middle ground, on which there had formerly been only 4 feet of water at mean low tide.

No further work was done in the Penobscot River until 1883, when a new survey was made by Col. Blunt, under the provisions of the river and harbor act of 1882. Col. Blunt reported that the improvements made were satisfactory as far as they went, but the increasing commerce of Bangor demanded additional facilities. He submitted a project for widening the channel at Bangor 100 feet, making it 300 feet wide, and for widening, straightening, and deepening the river near Crosbys Narrows, at an estimated cost of $75,000. A project for this improvement was adopted in 1884, and work on it begun. While it was in progress the river and harbor act of 1886 called for another survey of the Penobscot River from Bangor to Bucksport Narrows. This survey was made in 1887, under the direction of Lieut. Col. Jared A. Smith, who submitted a project, January 11, 1888, for improving the river from Winterport to Bucksport at an estimated cost of $365,000. The project contemplated the securing of 22 feet at mean low tide between Bucksport and Winterport, by means of contraction works assisted by dredging. The estimated cost of the two projects combined was thus made $440,000, of which $85,000 had already, in 1888, been appropriated. The act of September 19, 1890, appropriated $25,000, and provided for dredging near Sterns Mill. This was no part of any of the projects submitted, but was ordered by Congress.

In the river and harbor act of September 19, 1890, Congress directed still another survey to be made of the Penobscot River, Maine. This was done by Lieut. Col. Jared A. Smith, Corps of Engineers, and a report was submitted which was published as House Ex. Doc. No. 37, Fifty-second Congress, first session. The works of improvement suggested in this report are to still further widen the channel at Bangor on the Brewer side 60 feet, making it 360 feet wide, keeping the same depth as before; to deepen the river between Winterport and Bucksport, by the construction of jetties, to 22 feet at mean low tide, and near Crosbys Narrows to 12 feet by the same means. The estimated cost of this last project is $202,000.

The following appropriations have been made for the Penobscot River:

March 2, 1829 (for survey)	$300
July 11, 1870 (at Bangor and below)	15,000
March 3, 1871 (at Bangor and below)	50,000
June 10, 1872	40,000
March 3, 1873	20,000
June 23, 1874	20,000
March 3, 1875 ($10,000 to be expended at or near Bucksport Narrows)	25,000
August 14, 1876 ($4,000 to be expended at or near Bucksport Narrows)	10,000
June 18, 1878 ($2,500, or so much thereof as necessary, to be expended at or near Bucksport Narrows)	12,000
March 3, 1879	6,000
July 5, 1884 (for Bangor Harbor and Penobscot River)	20,000
August 5, 1886 (for widening channel at Bangor and removing obstructions near Crosbys Narrows)	15,000
August 11 1888 ($20,000 to be expended between Bangor and Crosbys Narrows, and $30,000 between Bucksport and Winterport)	50,000
September 19, 1890 (for continuing improvement and for dredging near Stern's Mill)	25,000
	308,300

The expenditures under the various projects up to the close of the fiscal year ending June 30, 1891, amounted to $278,746.02. The results accomplished were the widening and deepening of the channel at Bangor from a depth of 6 feet at extreme low tide to 12 feet; the removal of rocks, ledges, and other obstructions; the removal of the shoal near Bucksport, and a general increase in depth and width of channels from the mouth up to Bangor.

The expenditures during the last fiscal year were $5,586.85, making the total expenditures for the work $284,332.87.

At the date of the last annual report a contract was in progress for dredging the shoal above Crosbys Narrows. The work was completed November 2, 1891. The entire quantity of material dredged was 60,004 cubic yards, of which 50,430 cubic yards had been dredged previous to the last year.

The act of September 19, 1890, appropriated $25,000 for continuing the improvement, and for dredging near Sterns Mill, which is between Bangor and Crosbys Narrows. Under this appropriation it was proposed first to remove, by dredging, the shoal at Sterns Mill, and to apply any remaining balance of the funds to the removal of a similar shoal about one-half a mile below. The work was advertised August 31, 1891, and the bids opened September 25, 1891. The lowest bidder was Andrew K. Stone, of Boston, Mass., at 26½ cents per cubic yard, scow measurement, and a contract was made with him November 14, 1891, the work to be completed on or before November 30, 1892. Dredging under this contract was commenced at Sterns Mill on May 18, 1892, and at the close of the fiscal year, June 30, 1892, about 12,000 cubic yards of material had been excavated.

Bangor, at the head of navigation, is a port of entry.

Money statement.

July 1, 1891, balance unexpended		$29,553.98
June 30, 1892, amount expended during fiscal year		5,586.85
July 1, 1892, balance unexpended		23,967.13
July 1, 1892, outstanding liabilities	$415.00	
July 1, 1892, amount covered by uncompleted contracts	22,500.00	
		22,915.00
July 1, 1892, balance available		1,052.13
Amount appropriated by act approved July 13, 1892		40,000.00
Amount available for fiscal year ending June 30, 1893		41,052.13
Amount (estimated) required for completion of existing project		290,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging in Penobscot River, Maine, September 25, 1891.

No.	Name and address of bidder.	Price per cubic yard, measured in scow.
1	Moore & Wright, Portland, Me	$0.45
2	Thomas Symonds, Leominster, Mass	.48
3	Andrew K. Stone, Boston, Mass	.26¼
4	Robert Hamilton, Chebeague, Me	.26¾
5	A. B. Martin, Boston, Mass	.50
6	National Dredging Co., Wilmington, Del	.43

Contract made with Andrew K. Stone, November 14, 1891.

Abstract of contracts for dredging in Penobscot River, Maine, in force during the fiscal year ending June 30, 1892.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard, measured in scow.
1*	Thomas Symonds, Leominster, Mass.	Apr. 22, 1889	Dredging shoal above Crosbys Narrows.	$0.17
2	Andrew K. Stone, Boston, Mass	Nov. 14, 1891	Dredging shoal near Sterns Mill	.26¼

* Contract completed.

COMMERCIAL STATISTICS.

Receipts and shipments.	1890.	1891.
	Tons.	*Tons.*
Ashes		500
Bricks	17,000	8,575
Coal	147,260	104,113
Farm produce		2,025
Fish and oysters		107
Grain and flour	32,372	11,865
General merchandise		51,333
Hay, wood, etc	27,290	72,220
Iron, castings, etc	5,460	505
Ice	435,000	270,000
Lime and cement	3,394	568
Lumber	414,099	320,000
Miscellaneous	235,542	53,728
Oil	3,010	2,500
Plaster		1,400
Stone and slate	32,093	30,500
Salt	2,039	1,841
Total	1,354,559	931,780

Number of vessels arriving in calendar year 1891.

	No.	Tonnage.
Steamers drawing 10 feet or more	452	508,204
Steamers drawing less than 10 feet	433	120,517
Sailing vessels drawing 10 feet or more	790	183,155
Sailing vessels drawing less than 10 feet	881	45,242
Barges and flatboats	18	16,597

A 9.

IMPROVEMENT OF BELFAST HARBOR, MAINE.

Before the improvement was begun the harbor was not deep enough to accommodate the steamers and other vessels that visited the port. Near Lanes Wharf there was a shoal on which the depth was only about 4 feet at mean low tide, but it deepened toward the mouth of the harbor.

A survey was made of the harbor in 1875 and a report submitted. As a result of the survey it was ascertained that to so improve the harbor as to afford a safe anchorage for shipping in all storms, and have a suitable depth for the several steamers and other vessels that touch and lie there in all stages of the tide, would require the removal of certain shoals and the construction of a breakwater or breakwaters at the entrance to the harbor. The estimated cost was $347,000. The dredging alone was estimated to cost $35,000. The latter was in 1876 the project adopted. The construction of the breakwaters was abandoned.

The project contemplated dredging the lower part of the shoal water to 12 feet at low tide between the channel and the wharf line as far up as the wharf of the Boston and Bangor line of steamers, and from thence between the channel and the wharf line up to near Lanes Wharf to 10 feet at low tide. That project was completed in 1879, at a cost of $22,000.

A new survey or examination of the harbor was ordered in the river and harbor act of August 11, 1888. This was made, and a new project adopted in 1890. The new project proposes to dredge a channel from the deep water at the entrance to the upper harbor 220 feet wide and 15 feet deep at mean low tide; to dredge an area 8 feet deep on the north side of the harbor, so that vessels of that draft can reach the wharf in front of Pierce's ice house and mills at low tide; to dredge an area on the south side of the channel to a depth of 13 feet at mean low tide, to accommodate vessels touching at the Boston and Bangor Steamboat Company's wharf. The estimated cost of the new project is $52,000.

The following appropriations have been made:

Act of—	
August 14, 1876	$5,000
June 18, 1878	12,000
March 3, 1879	5,000
June 14, 1880	3,000
September 19, 1890	10,000
	35,000

The total expenditures on Belfast Harbor up to June 30, 1891, were $23,588.95. At the latter date a contract was in progress for dredging the area on the easterly side of the channel to the 8-foot depth proposed, which was the first work undertaken under the new project. At the close of the year 11,007 cubic yards of material had been dredged.

The expenditures during the last fiscal year were $11,411.05, which exhausted the funds. The contract for dredging the 8-foot area, which was in progress at the date of the last Annual Report, was completed October 1, 1891, the total amount dredged being 69,110 cubic yards, scow measurement. This completed the 8-foot dredging contemplated by the project, and leaves the 13-foot and 15-foot dredging yet to be done.

Belfast is in the collection district of Belfast. The nearest light-house is Dice Head, near Castine.

Money statement.

July 1, 1891, balance unexpended	$11,411.05
June 30, 1892, amount expended during fiscal year	11,411.05
Amount appropriated by act approved July 13, 1892	10,000.00
Amount (estimated) required for completion of existing project	32,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	32,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

Receipts and shipments during calendar year 1891.

	Tons.		Tons.
Coal	10,710	Ice	13,000
Farm produce	910	Lime	1,325
Fertilizers	1,500	Stone	7,000
Grain	5,029	Wood	980
Hay	7,127		
General merchandise	20,112	Total	71,093
Lumber	3,400		

These statistics were furnished by the collector of customs and H. E. Peirce, of Belfast, Me.

A 10.

IMPROVEMENT OF HARBOR AT CAMDEN, MAINE.

A survey was made of Camden Harbor in 1872, with a view to the improvement of its navigation, which prior to that time had been obstructed by the shoalness of the water over nearly all its area, there being less than 12 inches depth over the most of it.

The first project was for regulating the entrance, by dredging, between the two principal steamboat wharves, which were located on opposite sides of the entrance; dredging a channel about 1,500 feet long, 100 feet wide and 7 feet deep at mean low tide, from the entrance up to the head of the wharves on the easterly side of the harbor; and a channel 1,400 feet long, of the same width and depth, extending up to the head of the wharves on the westerly side of the harbor. The total excavation required was about 90,000 cubic yards, and the estimated cost $33,000. The total amount actually expended on the project was $20,000, and with the expenditure of this amount the project was completed in 1876.

In the harbor and river act of 1886, a new survey of Camden Harbor was ordered. This was made in 1887, and a project submitted for further improvement of the harbor. The dredged channels which had been made under prior appropriations, though they had not filled up to any appreciable extent, were not deep and wide enough to accommodate the increasing commerce. The new project comtemplates: (1) The dredging of an area at the entrance to the harbor and near the Boston Steamboat Wharf, to a depth of 12 feet at mean low tide; (2) the dredging of an area at the entrance so as to afford more easy access to the harbor, to a depth of 10 feet at mean low tide; (3) the dredging of a channel along the wharf line on the west side of the harbor as far up as Aldens Wharf to a depth of 10 feet, and from thence up to the Anchor Factory and to Derow's shipyard to a depth of 5 feet at mean low water; (4) the dredging of a channel on the east side nearly up to Gilkeys Wharf to a depth of 10 feet, and from thence up to Dailey's shipyard to a depth of 5 feet at mean low tide. These channels to be about 50 feet wide at the upper end, where the depth is to be 5 feet, and about 100 feet wide where the depth is to be 10 feet.

The removal of the middle ground, that is, the space between the two channels, though desirable, was not regarded as an essential part of the project and was not to be undertaken until the other parts had been completed. Subsequently its removal was included in the project. The estimated cost of the entire work was $60,000.

The following appropriations have been made:

Act of—	
March 3, 1873	$10,000
June 23, 1874	10,000
August 11, 1888	5,000
September 19, 1890	6,000

The expenditure of the first two appropriations resulted in giving a good entrance to the harbor, and two channels, one on each side along the lines of wharves, not less than 6 feet deep at mean low tide.

The total expenditures up to the close of the fiscal year ending June 30, 1891, inclusive of both projects, amounted to $25,031.17. As a result, the western channel had been dredged to a depth of 10 feet at mean low tide throughout its entire length, including the approach. The width for a distance of about 1,150 feet from the lower end was 75 feet, and from thence to the upper harbor it was 50 feet.

The expenditures during the last fiscal year were $5,968.83, exhausting the funds. The operations consisted in widening the western channel. The work was done by contract, which was completed September 3, 1891, the quantity dredged being 30,664 cubic yards, scow measurement. By this dredging the approach to the western channel was widened to a width of 125 feet and the channel itself to a width of 100 feet throughout its entire length.

Camden is the collection district of Belfast. The nearest light-house is on Negro Island, at entrance to harbor.

Money statement.

July 1, 1891, balance unexpended	$5,968.83
June 30, 1892, amount expended during fiscal year	5,968.83
Amount appropriated by act approved July 13, 1892	12,000.00
Amount (estimated) required for completion of existing project	37,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	37,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

Receipts and shipments during calendar year 1891

	Tons.		Tons.
Bricks	2,000	Lime	7,500
Coal	9,000	Fish and oysters	40
Cotton	80	Miscellaneous	1,075
Farm produce	1,900	Stone	1,000
Grain	6,000	Wood	600
Hay	200	Wool	180
Iron	7,000		
Lumber	9,000	Total	45,575

Number of vessels arriving and departing during calendar year 1891 (estimated).

Sailing vessels	324
Steamers	1,180
Total	1,504

A 11.

IMPROVEMENT OF HARBOR AT ROCKPORT, MAINE.

Rockport Harbor is a small harbor, though of considerable commercial importance, on the west side of Penobscot Bay.

Before the improvement was commenced the available depth along the wharves in the upper part of the harbor was but 4 feet at mean low tide.

The project, adopted in 1888, provided for dredging the shoal area in the upper harbor to a depth of 12 feet at mean low tide, and for removing a small ledge at the eastern side of the area proposed to be dredged, to the same depth. The estimated cost of the work was $14,000.

The mean range of tides is 9. 8 feet.

The following appropriations have been made:

By act of August 11, 1888	$10,000
By act of September 19, 1890	5,000

The expenditures up to the close of the fiscal year ending June 30, 1891, amounted to $10,088.81. At the latter date more than two-thirds of the area included in the project had been dredged to the full depth of 12 feet at mean low tide.

The expenditures during the past fiscal year were $4,911.19, exhausting the funds. Work was commenced under contract on August 4, 1891, and completed August 18, 1891, by which 15,000 cubic yards of material, scow measurement, were dredged, and 60 cubic yards of ledge removed. This completed the project.

Rockport is in the collection district of Belfast. The nearest light-house is on Indian Island at entrance to harbor.

Money statement.

July 1, 1891, balance unexpended	$4,911.19
June 30, 1892, amount expended during fiscal year	4,911.19

A 12.

IMPROVEMENT OF HARBOR AT ROCKLAND, MAINE.

The location of Rockland Harbor is such that, besides accommodating its own commerce, it affords a convenient refuge for large numbers of coasting vessels. When the project for a breakwater was adopted the harbor was open to easterly storms, the anchorage was unsafe, and the seas often broke over the wharves.

The following appropriations have been made for the improvement of Rockland Harbor:

Act of June 14, 1880	$20,000
Act of August 2, 1882	40,000
Act of July 5, 1884	40,000
Act of August 5, 1886	22,500
Act of August 11, 1888	30,000
Act of September 19, 1890	37,500
	190,000

The project as originally adopted in 1881 provided for two breakwaters, one starting from Southwest Ledge, in the harbor, and running in a northerly direction toward Jameson Point, a distance of 2,640 feet, the other starting from Jameson Point, and extending southward about 1,900 feet. The estimated cost was $550,000. The top of each breakwater was to be only 5 feet above the level of mean low tide.

In 1887 the project was amended so as to bring the top of the breakwater from Jameson Point to the level of high tide, leaving the other as originally designed. The estimated cost was thus increased to $650,000.

In 1890 the project was again modified. Instead of building the second breakwater from Southwest Ledge in a northerly direction, on which no work had been done, it was decided to prolong the one from Jameson Point in a southerly direction. By doing so a much larger area of the harbor would secure protection. The estimated cost of the new project was $632,500, this being inclusive of the cost of the part already constructed.

Up to the close of the fiscal year ending June 30, 1891, there had been expended on the breakwater the sum of $153,058.51, and about 156,500 tons of stone had been placed in position. The above expenditures had resulted in protecting a part of the harbor, giving a secure harbor of refuge for many vessels that trade near this port.

During the fiscal year ending June 30, 1892, there has been expended the sum of $16,326.97. This expenditure has added to a small extent to the area of protected harbor. During the year there has been deposited about 23,500 tons of stone in the breakwater, the price paid being 78½ cents per ton of 2,000 pounds, the work being done by contract by William S. White, of Rockland, Me. Up to the close of the year there had been deposited in the entire breakwater about 180,000 tons of stone.

Money statement.

July 1, 1891, balance unexpended		$36,941.49
June 30, 1892, amount expended during fiscal year		16,326.97
July 1, 1892, balance unexpended		20,614.52
July 1, 1892, outstanding liabilities	1,907.10	
July 1, 1892, amount covered by uncompleted contracts	18,178.93	
		20,086.03
July 1, 1892, balance available		528.49
Amount appropriated by act approved July 13, 1892		30,000.00
Amount available for fiscal year ending June 30, 1893		30,528.49
Amount (estimated) required for completion of existing project		412,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

COMMERCIAL STATISTICS.

Receipts and shipments.	1890.	1891.
	Tons.	*Tons.*
Bricks, cement, and sand	3,709	3,697
Coal	81,205	83,505
Fish, oysters, and salt	2,866	2,569
Grain and flour	5,084	6,147
General merchandise and miscellaneous	64,818	67,579
Ice	5,500	4,672
Lumber	23,234	24,376
Lime	150,000	160,000
Stone	54,200	54,778
Wood and cooperage	71,950	76,237
	411,566	433,760

Number of vessels arriving in calendar year 1891.

Steamers from 400 tons to 1,200 tons each	342
Steamers from 75 tons to 200 tons each	886
Sailing vessels, foreign, average about 90 tons each	664
Sailing vessels, coastwise trade	2,300
Sailing vessels, for refuge only	2,300
Total	6,492

Three new steamboat lines were established during the year from Rockland to Islesboro, to Vinalhaven, and to Port Clyde, Me.

A 13.

IMPROVEMENT OF KENNEBEC RIVER, MAINE.

Congress recognized the importance of improving the Kennebec River as early as 1827, when an appropriation was first made. Appropriations aggregating $18,500 were made between 1827 and 1852. From 1852 to 1866 no work was done by the General Government, but the citizens of Augusta within this period undertook to dredge out a channel above Sheppard's Point, and they improved it in some localities, but the material was not removed a sufficient distance from the channel, and from that and other causes it filled up again.

The act of June 23, 1866, appropriated $20,000 for the improvement of the upper part of the river, between Sheppard's Point and Augusta, a length of about 3 miles. The project for this improvement consisted in removing rocks and straightening and deepening the channel, which was obstructed by several shoals, to a depth of 8 feet up to Hallowell and 7 feet from thence to Augusta. The estimated cost was $50,000. The projected width of channel was fixed at first at 75 feet.

In 1868, after a survey of the river had been made from Augusta to Gardiner, the project was amended so as to include all that part of the river from Gardiner to Augusta, and the width fixed at 100 feet. The amended project was estimated to cost $80,000. In 1871 the project was again extended by act of Congress, which appropriated $5,000 for improving the river between Gardiner and Richmond. This part of the river it was proposed to improve so as to give 10 feet at low tide up to Gardiner. This necessitated the removal of a ledge near Nehumkeg Island, of ledges and bowlders at other points, the dredging of a channel through the Upper Sands Bar and one near the head of Swan Island. The estimated cost of this additional project was about $13,000.

By July 1, 1872, all the work contemplated in the various projects for improving the Kennebec from Richmond up to Gardiner had been completed. There were, however, several rocks in the main channel of the river at Lovejoy Narrows, on the east side of Swan Island, which were a source of danger to shipping. One of them, known as "Half-tide Rock" had been excavated to a depth of 8 feet at low tide, but as this gave only about 13 to 14 feet at high tide it was not sufficient to accommodate commerce. In the Report of the Chief of Engineers for 1872 the removal of some of these rocks to a depth of 12 feet at mean low tide was suggested, at an estimated cost of $13,500. A survey of two of the ledges was made in 1872, when it was found they were larger than was expected, so that the estimate was increased to $30,603.61. A more accurate survey was made in 1874, and other small sunken ledges were found. In that year the adopted project consisted in removing Ledges III, IV, V, and Dry Rock, all to a depth of 12 feet at mean low tide. Ledge I (Half-tide Rock) had been completed to 12 feet in November, 1873, and Ledge II was omitted from the project, as the removal of Dry Rock seemed to render the removal of Ledge II unnecessary.

In 1877 all the dangerous rocks in Lovejoy Narrows had been removed to a depth of 12 feet at mean low tide, which completed all projected improvements in the Kennebec River.

No further work was done on the river until 1880, when a survey was made in obedience to the requirement of the harbor and river act of June 14, 1880, of Richmond Harbor, at the head of Swan Island, with a view to its improvement. The project suggested for this improvement, which was adopted in 1881, was to give a navigable channel not less than 10 feet deep at mean low water on the shoals at the upper end of Swan Island and at Hatchs Rock, about 2 miles below, and 11 feet at the lower end of Swan Island, about 5 miles below the town of Richmond.

The estimated cost of the project was $20,500. This project was completed in 1883.

In the harbor and river act of 1886 a new survey of the Kennebec River was ordered at Bath, and from Augusta to the lower end of Perkins Island. This survey was made in 1887, and a new project for the improvement of the river from Bath to Augusta was submitted. The project submitted consists in removing the shoals at Beef Rock, at Hatchs Rock, and near South Gardiner by means of wing dams and training walls, and dredging, the removal of rocks at Bath and at Lovejoy Narrows by blasting, and the dredging of a channel through the shoals between Augusta and Gardiner, and the removal of the old piers of the bridge at Hallowell. The depths were to be as follows: At Beef Rock Shoal 12 feet, at Hatchs Rock 9 feet, at Lovejoy Narrows 18 feet, at Upper Sands Bar 12 feet, at Hallowell Shoal 10 feet, and from thence to Augusta, 8 feet—all at low tide.

The estimated cost of the entire project was $410,500. In 1888, an appropriation of $75,000 having been made for the improvement of the Kennebec River, a project for the expenditure of the appropriation in improving Hatchs Rock and Beef Rock Shoals was approved. Subsequently owing to dredging which had to be done, and which was not contemplated in the original project, the estimated cost of the entire improvement was increased to $428,500. All of the appropriation made by act of September 19, 1890, was also expended on Beef Rock and Hatchs Rock Shoals and the removal of the piers of the old bridge at Hallowell.

The following appropriations have been made:

March 2, 1827	$4,000	June 10, 1872	$8,000
March 19, 1828	3,500	March 3, 1873	12,000
April 23, 1830	5,000	June 23, 1874	12,000
August 30, 1852	6,000	March 3, 1875	15,000
June 23, 1866	20,000	March 3, 1881	10,000
March 2, 1867	30,000	August 11, 1888	75,000
April 10, 1869	14,850	September 19, 1890	50,000
July 11, 1870	15,000		
March 3, 1871	15,000	Total	295,350

The total expenditures on the river up to June 30, 1891, were $280,381.43. The results accomplished may be stated thus:

Before the improvements were commenced the main channel between the foot of Swan Island and Gardiner (15 miles) was obstructed by a shoal at the foot of Swan Island with only 10 feet on it at mean low tide, by dangerous ledges in Lovejoy Narrows, by a shoal below South Gardiner with only 8 feet of water on it at mean low tide, and by a ledge in the channel at Nehumkeg Island. This part of the river has been improved by dredging, contraction works, and removal of ledge, so as to give a good channel 12 feet deep at mean low tide as far up as Gardiner, except over the shoal below South Gardiner. A channel was dredged through this shoal to a depth of 10 feet at mean low tide, but gradual filling has since reduced this depth to 9 feet.

The steamboat channel to the westward of Swan Island has been improved by dredging and contraction works so as to give a depth of 9 feet at mean low tide. The former depth over the shoals was but 7½ feet.

The channel between Gardiner and Augusta (6½ miles) was obstructed by shoals with a depth of water on them of only 3½ feet at low summer tide. This depth was increased by dredging to 7 feet between Gardiner and Hallowell, and 6½ feet between Hallowell and Augusta. Gradual shoaling has since reduced the available channel depth to 6 feet between Gardiner and Hallowell, and to 5 feet between Hallowell and Augusta. Three old bridge piers were also removed from the channel of the river at Hallowell.

The expenditures during the year ending June 30, 1892, have been $8,411.39, which were applied to the payment of liabilities incurred during the previous fiscal year, and to the redredging of the channel at Beef Rock, which had filled up since the last dredging was done. This was to have been expected, as the jetty in its unfinished condition could hardly be expected to keep the channel open. There have been about 30,000 cubic yards of sand taken from this channel during the fiscal year. The work was done by contract, at a cost of 17½ cents per cubic yard.

The improvement is in the collection district of Bath, of which Bath is the port of entry. Fort Popham and the light-house on Pond Island are near the mouth of the river.

Money statement.

July 1, 1891, balance unexpended		$14,968.57
June 30, 1892, amount expended during fiscal year		8,411.39
July 1, 1892, balance unexpended		6,557.18
July 1, 1892, outstanding liabilities	$314.89	
July 1, 1892, amounted covered by uncompleted contracts	3,351.07	
		3,665.96
July 1, 1892, balance available		2,891.22
Amount appropriated by act approved July 13, 1892		100,000.00
Amount available for fiscal year ending June 30, 1893		102,891.22
Amount (estimated) required for completion of existing project		203,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for dredging in Kennebec River, Maine, April 13, 1892.

No.	Name and address of bidder.	Price, per cubic yard, measured in scow (30,000 cubic yards).	Amount.
1	Moore & Wright, Portland, Me	$0.17½	$5,250
2	Hamilton & Sawyer, Cumberland County, Me	.25	7,500
3	National Dredging Co., Wilmington, Del	.21	6,300

Contract made with Moore & Wright, April 19, 1892.

Abstract of contracts for improving Kennebec River, Maine, in force during the fiscal year ending June 30, 1892.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price.
*1	Samuel S. Jordan, Bath, Me F. W. Carlton, Woolwich, Me	Dec. 17, 1890	Removal of old bridge piers	$2,423
2	Moore & Wright, Portland, Me	Apr. 19, 1892	Dredging Beef Rock Shoal	17½ cents per cubic yard, in scow.

* Contract completed.

COMMERCIAL STATISTICS.

Receipts and shipments.	1890.	1891.
	Tons.	*Tons.*
Bricks		1,903
Coal		123,356
Cement		335
Grain		150
General merchandise		22,400
Granite		12,000
Hay	8,500	13,255
Ice	1,000,000	846,165
Iron		830
Lime		245
Lumber	201,894	186,523
Salt		2,212
Wood		1,100
Total	1,210,394	1,210,474

Number of vessels arriving and departing during the calendar year 1891.

Steamers of about 1,600 tons each	384
Steamers	730
Steamers	480
Sailing vessels, average 400 tons each	7,890
Total	9,484
Steam tugs plying in the river	17
Vessels built during 1891 (average 822 tons each)	39

A 14.

IMPROVEMENT OF HARRASEEKET RIVER, MAINE.

The act approved March 3, 1881, provided that a survey be made of this river. The survey was made in July of that year, and a report was submitted in December by the engineer of the district.

The river empties into Casco Bay at Stocksbridges Point, about 12 miles northeast of Portland. From Stocksbridges Point up to Westons Point the depth of water is no less than 10 feet at mean low tide, with no obstructions to navigation. From Westons Point up to Freeport Landing, a distance of 4,500 feet, the depth diminishes so that for the greater part of the distance the bottom of the river is 3½ feet out of water at mean low tide. The rise and fall of tides here is 9 feet. The project recommended in 1881 was the dredging of a channel not less than 60 feet wide and 3 feet deep at mean low tide up to Freeport, and a turning basin 180 feet wide at the head of the channel. The estimated cost of the improvement recommended was $13,000.

No appropriation was made for the work, however, and a new survey was ordered in the harbor and river act of 1888. A project for the improvement was submitted January 4, 1889. This project was on a somewhat larger scale than the one previously suggested, and contemplated a depth of channel of 5 feet at mean low tide, which would give about 14 feet at high tide.

The estimated cost of the project was $36,000.

The following appropriation has been made: September 19, 1890, $10,000.

No work had been done up to the close of the fiscal year ending June 30, 1891, as it was not deemed expedient to expend any money on it until sufficient funds had been appropriated to accomplish some good results, which could not be done with the amount of the first appropriation alone.

There were no expenditures during the fiscal year ending June 30, 1892, and no work was done.

The river is in the collection district of Portland and Falmouth. The nearest light-house is on Halfway Rock.

Money statement.

July 1, 1891, balance unexpended	$10,000.00
July 1, 1892, balance unexpended	10,000.00
Amount appropriated by act approved July 13, 1892	16,000.00
Amount available for fiscal year ending June 30, 1893	26,000.00
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	10,000.00
Submitted in compliance with requirements of sections 2 of river and and harbor acts of 1866 and 1867.	

A 15.

IMPROVEMENT OF PORTLAND HARBOR, MAINE.

The commercial importance of Portland was recognized in the early days when Congress began a system of internal improvements for the country. The first appropriations were made for the construction of a breakwater on Stamford Ledge in Portland Harbor, according to the plan of John Anderson, of the Corps of Engineers, in 1836. Subsequent appropriations ran the aggregate up to about $166,000. The breakwater was completed in 1875, according to the plans of Col. B. S. Alexander, which plans had been submitted to and approved by a Board of Engineers, consisting of Col. H. Bache, Lieut. Col. George Thom, and Maj. T. L. Casey, in 1867.

The first regular appropriation for deepening the waters of the harbor was made in 1870, though by joint resolution of Congress, approved June 5, 1868, the Chief of Engineers was authorized to expend so much of the unexpended balance of the appropriation of 1866 for the breakwater as he might deem proper in excavating the middle ground near said breakwater and in otherwise protecting and improving the channel, so that the appropriation of 1866 for the breakwater and subsequent appropriations for improving Portland Harbor were expended partly on the breakwater and partly in dredging.

The first regular project for dredging the harbor was submitted by Col. George Thom, June 30, 1868, in which he recommended the excavation of a channel 300 feet wide through the southern slope of the middle ground to a depth of 20 feet at mean low tide and the removal of the bar off Grand Trunk Wharves to the same depth. The project was approved. The estimated cost was $28,600.

The estimated cost of completing the breakwater at the time this report was made was $59,984, and as $92,000 of the appropriation of 1866 was at that time available, no additional funds were needed over what had already been appropriated.

In 1869 an extension of the breakwater 190 feet was added to the project, and subsequently a further extension of 200 feet was ordered.

In 1870 the project for the channel improvement was amended so as to provide for a channel 400 feet wide, instead of 300, and in 1871 it was still further added to by making it 500 feet wide, the extra cost of these additions to the project being $65,000.

The act of Congress of June 10, 1872, made an appropriation of $45,000 for Portland Harbor and Back Bay. The approved project for this latter improvement was estimated to cost $15,000. The improvement contemplated was the enlargement, by dredging, of the channel leading from Tukeys Bridge southwardly to the stone wharves.

In December, 1872, there was added to the project a plan to dredge the inner harbor to a depth of 16 feet up to the harbor commissioner's lines, beyond which several wharves extended. The estimated cost of this additional improvement was $110,000, but it was not designed to expend it until the outer ends of the projecting wharves had been removed. By 1876 all the work projected for the improvement of the harbor had been completed except the dredging in the inner harbor in front of the harbor commissioner's lines, above Merrills Wharf.

The total expenditures up to 1876 had been $306,908.07, which expenditures had been of great benefit to the commerce of the city.

No appropriation was made between 1875 and 1881.

A resurvey of the harbor was made in 1880, which showed that the dredged channels up to that time had not deteriorated.

A new appropriation was made in 1881, and with a view to the further improvement of the harbor a project and estimate for the removal of the entire area of the shoal known as the middle ground to a depth of 21 feet, at an estimated cost of $160,000, was adopted. The work on this latter project was continued until 1885, when it was completed. The total expenditures on the entire harbor up to June 30, 1885, were $427,929.21. In 1886 the Board of Trade and other parties interested asked for still further improvement of the harbor to a depth of 29 feet at mean low tide. A project for this improvement, at an estimated cost of $135,000, was approved in 1886. In 1890 the project was extended to include some dredging in the upper harbor to 16 feet, at an estimated cost of $5,000. Work on the amended project is now in progress.

The following appropriations have been made:

July 4, 1836, for breakwater	$10,000.00
March 3, 1837, for breakwater	25,000.00
July 7, 1838, for breakwater	26,366.00
June 23, 1866, for extending breakwater, but unexpended balance made available for excavating middle ground by joint resolution of June 5, 1868	105,111.05
July 11, 1870, for improving harbor	10,000.00
March 3, 1871, for improving harbor	40,000.00
June 10, 1872, for improving Portland Harbor and Back Bay	45,000.00
March 3, 1873, for improving harbor	50,000.00
June 23, 1874, for improving harbor	20,000.00
March 3, 1875, for improving harbor	20,000.00
March 3, 1881, for improving harbor	20,000.00
August 2, 1882, for improving harbor	35,000.00
July 5, 1884, for improving harbor	30,000.00
August 5, 1886, for improving harbor	30,000.00
August 11, 1888, for improving harbor	40,000.00
September 19, 1890, for improving harbor	40,000.00
	546,477.05

The total expenditures up to June 30, 1891, were $505,360.40.

Before the improvement of the harbor was begun the greatest depth at mean low tide across the bar between the middle ground and Stamford Ledge was 16 feet, while the depth on the middle ground itself was only from 8 to 10 feet at mean low tide. The depth in the inner harbor along the front of the wharves was in places no more than 4 feet. The expenditures have resulted in removing the entire area of the middle ground up to the harbor commissioner's line, giving a wide and commodious entrance 29 feet deep at mean low tide, also in giving a depth of 16 feet at mean low tide within the inner harbor along the wharves and up to the harbor commissioner's lines and a breakwater to protect the anchorage.

The expenditures in the fiscal year ending June 30, 1892, have been $4,302.44. This expenditure has been in continuation of the 29-foot project, and when the existing contract is completed it will give a channel entrance 500 feet wide and 29 feet deep, which will complete that part of the project. There only remains a small amount of dredging in the upper harbor to complete the entire project.

The total amount of dredging done in the harbor up to the end of the fiscal year ending June 30, 1892, has been about 1,382,215 cubic yards, exclusive of what has been done under the existing contract. The total amount of stone built in the breakwater is about 45,000 tons.

The harbor is defended by Forts Preble, Gorges, Scammel, and a battery at Portland Head. There is a light-house on the breakwater and one at Portland Head, 3 miles distant from the city. The harbor is in the collection district of Portland and Falmouth, of which Portland is the port of entry.

Money statement.

July 1, 1891, balance unexpended		$41, 116. 65
June 30, 1892, amount expended during fiscal year		4, 302. 44
July 1, 1892, balance unexpended		36, 814. 21
July 1, 1892, outstanding liabilities	$763. 09	
July 1, 1892, amount covered by uncompleted contracts	33, 856. 74	
		34, 619. 83
July 1, 1892, balance available		2, 194. 38
Amount appropriated by act approved July 13, 1892		30, 000. 00
Amount available for fiscal year ending June 30, 1893		32, 194. 38

COMMERCIAL STATISTICS.

Receipts and shipments.	1890.	1891.
	Tons.	*Tons.*
Apples	7, 400	107, 801
Bacon, pork, etc	7, 227	810
Bricks	....	4, 675
Coal	450, 000	600, 000
Cattle (on the hoof)	....	3, 185
Cement and lime	....	14, 915
Cotton	....	2, 874
Cooperage	....	2, 345
Fish	12, 150	13, 052
Flour and general merchandise	....	482, 626
Flour and grain	100, 530	29, 203
Hay	....	733
Ice	30, 000	6, 154
Iron, pipe, etc	2, 100	2, 773
Lumber	190, 810	39, 162
Miscellaneous	209, 569	20, 000
Molasses and sugars	51, 638	....
Oil	....	20, 862
Rags	3, 706	....
Salt	15, 586	364
Stone	....	635
Sand and clay	....	16, 068
Total	1, 078, 716	1, 368, 237

Number of arrivals in calendar year 1891.

Steamers, coast trade, from 1,100 tons to 1,500 tons each	*810
Steamers, foreign trade, from 3,000 tons to 6,000 tons, each	32
Sailing vessels, coastwise trade	998
Sailing vessels, for refuge only	5,573
Total	7,413
Vessels entered at the custom-house	628
Vessels cleared at the custom-house	568

A 16.

IMPROVEMENT OF CHANNEL IN BACK COVE, PORTLAND, MAINE.

The first work done in Back Cove was ordered in the river and harbor act of 1872. The project was for dredging a channel in "Back Bay" 100 feet wide and 8 feet deep at mean low water, from Tukeys Bridge to the "Stone-shed Wharves." The estimated cost was $10,000. The work was completed in January, 1874.

The act of August 5, 1886, appropriated $26,250 for continuing the improvement of Back Cove. A survey was made in 1886, and a project adopted having in view the straightening and deepening of the channel to a depth of 12 feet at mean low tide and to a width of 300 feet, following the harbor commissioner's lines along that part of the cove which borders the city, a distance of about 5,600 feet, with a turning basin at the upper end. The estimated cost of this project was $181,000, which, in 1888, was revised in consequence of a trifling modification in the location, and put at $180,000. This project is now in process of execution.

The following appropriations have been made:

Act of June 10, 1872, for improvement of Portland Harbor and Back Bay	$45,000
Act of August 5, 1886	26,250
Act of August 11, 1888	25,000
Act of September 19, 1890	25,000

When work under the existing project was commenced the channel had a depth at low tide of about 8 to 10 feet for about one-half its length; in portions of the remaining length the depth at low tide did not exceed 1 foot.

The expenditures to the close of the fiscal year ending June 30, 1891, under the existing project, amounted to $51,634.31. At the latter date the channel had been extended for a distance of 4,050 feet, 12 feet deep at low tide, and 90 feet wide, and a turning basin, 400 feet wide, excavated.

The expenditures during the past fiscal year were $57.30. No work was in progress, but during the present season dredging will be commenced under a contract made in 1891 with the National Dredging Company.

Back Cove is a part of Portland Harbor, and is therefore in the same collection district; is defended by the same forts, and the same light-houses are near it as are given for Portland Harbor.

---

[*] This does not include a number of steamers which ply from Portland to points in Casco Bay, 3 to 12 miles distant.

Money statement.

July 1, 1891, balance unexpended	$24,615.69
June 30, 1892, amount expended during fiscal year	57.30
July 1, 1892, balance unexpended	24,558.39
July 1, 1892, amount covered by uncompleted contracts	22,500.00
July 1, 1892, balance available	2,058.39
Amount appropriated by act approved July 13, 1892	20,000.00
Amount available for fiscal year ending June 30, 1893	22,058.39
Amount (estimated) required for completion of existing project	83,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Receipts and shipments.	1890.	1891.
	Tons.	*Tons.*
Coal	9,552	11,586
Clay and sand	12,529	15,868
Granite		635
Total	22,081	28,089

Number of vessels arrived in calendar year 1891.

Sailing vessels from 500 tons to 1,000 tons each	13
Sailing vessels from 250 tons to 500 tons each	42
Sailing vessels from 35 tons to 150 tons each	121
Total	176

A 17.

IMPROVEMENT OF SACO RIVER, MAINE.

The first appropriation made for the improvement of the Saco River was in 1827, when $7,000 was appropriated for the erection of piers, placing beacons and buoys, and removing obstructions at and near the entrance to the harbor. With the expenditure of these funds it appears that twelve piers were constructed within the river, the object of which was to keep vessels from drifting on to the rocks and ledges, and two outside piers which were evidently intended for breakwaters. No further appropriations were made until 1866, when an appropriation of $40,000 was made for continuing the repairs of piers in the Saco River.

In 1866 a plan was proposed by Mr. George Davidson, of the Coast Survey, for the construction of two stone piers conducting the river to the sea in a northeasterly direction, at an estimated cost of $40,000. In the same year Maj. B. S. Alexander, of the Corps of Engineers, submitted a plan for the construction of a breakwater between the two outside piers, 2,915 feet in length, 12 feet above low tide, the outer face to be of cut granite and the inner of rubble stone, the estimated cost of which was $192,500. The project of Maj. Alexander was modified at the suggestion of Col. George Thom, Corps of Engineers, by adding to it the repairing and rebuilding of the inside piers, the total cost of the entire project being estimated at $211,701. The latter project was approved March 28, 1867, with the condition that the position of the breakwater should first be determined by a Board of Engineers. Such a Board, consisting of Maj. Casey, Lieut. Col. Thom, and Col. H. Bache, approved the location proposed by Maj. Alexander, Corps of Engineers.

The estimated cost was subsequently increased to $270,000, and in 1868 to $320,000.

The project in 1868 was the construction of the breakwater at the mouth of the river, the removal of sunken rocks, and the rebuilding of some of the most important piers in the river. The coping or paving of the outer slope of the breakwater was afterwards dispensed with, and some of the other work was apparently done at a lower cost than the estimates, so that the entire project was completed in 1873 at a total cost of $169,275.

Nothing more was done from 1873 to 1882. In the latter year a resurvey of the breakwater was ordered by act of Congress. This survey was made in 1883 under direction of Col. Blunt, Corps of Engineers, and an estimate submitted for extending the breakwater out to Sharps Ledge, raising and repairing the one in existence, constructing another of less height on the south side of the entrance, and for dredging. The total estimated cost of the improvement was $356,000. The resurvey showed that the breakwater did not prevent the accumulation of sand on the south side of it, so that the bar had again become an obstruction.

In 1884 an appropriation of $15,000 was made for improving breakwater at mouth of Saco River and repairs to same. This was a single item in the foregoing estimate, and the improvements and repairs suggested were estimated to cost $70,000, so that the project for improvement at the mouth of the river became repairing and raising the existing breakwater to a height of 15 feet above mean low tide, and a width of 12 feet on top.

The same act of Congress that made an appropriation for the breakwater ordered a preliminary examination and survey of Saco River. A report of this survey was submitted October 16, 1885, and a project for improving the navigation of the river proper from its mouth to the towns of Saco and Biddeford was suggested, at an estimated cost of $50,000. This amount was expected to give a continuous channel of 6 feet at mean low tide to the head of navigation from inside the bar.

In 1886 two appropriations were made, one for the river proper and the other for the repair and completion of the breakwater. The same was done in 1888. In 1889 the engineer recommended that the two projects be combined in one. The revised estimate of the cost of the two was then put at $185,000—$30,000 to complete the breakwater, and $155,000 to give 6 feet at mean low tide from the sea to Biddeford and Saco at the head of navigation. This estimate included the construction of a jetty on the south side of the mouth of the river. The appropriation made in 1890 is understood to be for continuing work on the combined project.

The following appropriations have been made:

March 2, 1827 (For piers, buoys, and removing obstructions at and near entrance)	$7,000
June 23, 1866 (for repairing piers)	40,000
March 2, 1867 (for improving river)	40,000
July 25, 1868 (for improving river)	20,000
April 10, 1869 (for improving river)	22,275
July 11, 1870 (for improving river)	10,000
March 3, 1871 (for improving river)	15,000
June 10, 1872 (for improving river)	15,000
July 5, 1884 (for breakwater)	15,000
August 5, 1886 (for breakwater)	12,500
August 5, 1886 (for improving river)	12,500
August 11, 1888 (for breakwater)	12,500
August 11, 1888 (for improving river)	10,000
September 19, 1890 (for improving river including breakwater and jetty)	65,000
	296,775

The total expenditures on both river and breakwater up to June 30, 1891, have been $236,104.72.

The river before the improvement was begun was obstructed at its mouth by a bar on which there was only about 2 feet of water at low tide, though much of the river was deeper, and by ledges and bowlders. The swift currents also tended to sweep vessels on the rocks and ledges.

The expenditures up to June 30, 1891, have resulted in removing the dangerous ledges, constructing piers against which vessels could touch without danger of damage, the construction of a substantial breakwater on the north side of the entrance, and the partial construction of a jetty to contract the channelway on the south side. The breakwater on the north side has made navigation at the entrance easier, but the deepening of the water, which it was expected its construction would cause, has not yet been accomplished.

The expenditures during the fiscal year ending June 30, 1892, have been $20,832.50. The work in progress during the last fiscal year has been the construction of the south jetty under contract. About 35,000 tons of stone have been placed in the jetty, 8,626 tons of which were deposited during the fiscal year 1891. The work has been practically completed for a length of about 3,000 feet from the shore, which is nearly all that is covered by the existing contract. A deepening of the channel has been secured as far as the jetty has been built, but it is not long enough, and proposals have been invited for extending it about 1,000 feet farther, out to deep water, and for doing a small amount of dredging to assist the action of the currents and to afford immediate relief to commerce.

[*] Saco River is in the collection district of Saco, Me., of which Saco is the port of entry. The nearest light-house is Wood Island.

Money statement.

July 1, 1891, balance unexpended		$60,670.28
June 30, 1892, amount expended during fiscal year		20,832.50
July 1, 1892, balance unexpended		39,837.78
July 1, 1892, outstanding liabilities	$2,609.48	
July 1, 1892, amount covered by uncompleted contracts	14,544.60	
		17,154.08
July 1, 1892, balance available		22,683.70
Amount appropriated by act approved July 13, 1892		25,000.00
Amount available for fiscal year ending June 30, 1893		47,683.70
Amount (estimated) required for completion of existing project		72,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		72,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Commercial statistics.

Receipts and shipments.	1890.	1891.
	Tons.	*Tons.*
Bricks	6,160	6,000
Coal	33,015	40,724
Cement and lime	938	485
Iron	1,384	1,684
Lumber	738	80
Molding sand	565	480
Powder and ashes		92
Roofing gravel		220
Ice	1,212	
Granite	75	
Total	44,087	49,765

Number of vessels arriving in calendar year 1891.

Sailing vessels drawing 10 feet or more	130
Sailing vessels drawing less than 10 feet	66
Total	196

A 18.

IMPROVEMENT OF KENNEBUNK RIVER, MAINE.

The Kennebunk River is a small stream that empties into the Atlantic about 30 miles south of Portland. Formerly the shipbuilding industry on this river was very great, though the river itself was small. Of late years this industry has fallen off to almost nothing.

The first appropriation for the improvement of the river by the National Government was made in 1829. This was for repairing the pier on the east side of the channel at the entrance to the river, which had been constructed by private enterprise many years before. Appropriations were made between 1829 and 1852 for piers at the mouth of the river. These were designed to improve the course and depth of the channel entrance, and a wharf built a short distance upstream was for the security of vessels when they were detained by the tide and storms.

With the appropriations made in 1870 and 1871 the piers were extended and repaired and the wharf was also repaired. This work was completed in 1872.

In 1876 a project was adopted, the object being to afford a channel of navigable width from the mouth of the river up to Kennebunkport, a distance of about 1½ miles, and of a depth of not less than 4 feet at mean low tide, or 13 feet at high tide. This work was accomplished by dredging at the Wading Place and at Mitchells Point, and removing sunken ledges below Wards Wharf and others near the mouth of Gooch Creek so as to give a depth of 4 feet at mean low tide. The project was completed in 1882, but the dredged channels subsequently filled up again.

The river and harbor act of 1888 directed a survey of the Kennebunk River, which was made in 1889, and a new project submitted, the estimated cost of which was $20,000. The object of the work proposed was the repair of the jetties or piers at the mouth of the river, the repair of the wharf above, at which vessels tied up when detained by tides and storms, and the contraction of the stream at Wading Place, by a small stone jetty. The project was approved December 19, 1890, and its execution was commenced in 1891.

The following appropriations have been made:

March 2, 1829	$5,000	March 3, 1871	$5,000
March 2, 1831	1,175	August 14, 1876	5,000
February 24, 1832	1,700	March 3, 1879	2,000
June 28, 1834	10,300	June 14, 1880	2,000
July 2, 1836	7,500	March 3, 1881	2,000
March 3, 1837	3,000	September 19, 1890	20,000
July 7, 1838	8,000		
August 30, 1852	7,500	Total	85,175
July 11, 1870	5,000		

The expenditures up to June 30, 1891, have been $65,759.27. These expenditures have accomplished the construction of two piers or jetties at the mouth of the river and kept them in repair for many years, the construction and repair of the wharf, and some dredging, which was done years ago.

The expenditures during the year ending June 30, 1892, have been $14,152.44. These have been applied to the more permanent repair of the wharf, most of which has been done; to the partial protection of the base of the east jetty; and to the construction of the jetty or dike at Wading Place.

Proposals were invited for the completion of the work called for in the approved project, but only one bid was received at the time appointed for the opening, and it was not accepted, as the prices were regarded as too high. Proposals will be again invited.

There is but little commerce on the river and none is expected to be developed by the improvements. The place is visited chiefly by small sailing vessels and pleasure craft.

The river is in the collection district of Kennebunk, which is the nearest port of entry. The nearest light-house is on Goat Island near Cape Porpoise.

Money statement.

July 1, 1891, balance unexpended	$19,332.24
June 30, 1892, amount expended during fiscal year	14,152.44
July 1, 1892, balance unexpended	5,179.80
July 1, 1892, outstanding liabilities	235.00
July 1, 1892, balance available	4,944.80

Abstract of proposals for stone work at Kennebunk River, Maine, May 23, 1892.

No.	Bidders.	Dimension stone for wharf (420 tons).		Stone for backing (200 tons).		Stone for jetty (700 tons).		Fender timbers (5).	
		Price.	Amount.	Price.	Amount.	Price.	Amount.	Price.	Amount.
*1	George Willett Andrews, Biddeford, Me.	$2.75	$1,155.00	$2.25	$450.00	$1.65	$1,155.00	$25.00	$125.00

* Rejected, prices being too high.

COMMERCIAL STATISTICS.

Receipts and shipments.	1890.	1891.
	Tons.	*Tons.*
Coal	2,166	3,695
Lumber	1,814	1,000
Total	3,980	4,695

Number of vessels arriving in calendar year 1891.

Sailing vessels drawing from 10 feet to 12½ feet	20

A 19.

IMPROVEMENT OF HARBOR AT YORK, MAINE.

York Harbor is located at the mouth of York River, a small stream that empties into the Atlantic Ocean about 10 miles east of Portsmouth, N. H.

A survey was made in 1884 and a report thereon submitted in February, 1885, in which a project of improvement was suggested. This project had for its object (1) the removal by dredging of part of the spit off the southwest point of Stage Neck; (2) the removal of part of a sand shoal off Bragdons Island, and (3) the removal of the upper shoal just north of Bragdons Island. The object of the improvement was to widen and straighten the channel, which was very crooked and difficult to navigate, and give a navigable channel of 10 feet at mean low tide. The estimated cost of the project was $25,000.

The project was approved in 1886, after the first appropriation for the work was made and its execution was entered upon.

In 1887 it was found that the prices on which the estimate was based were too low, so the estimate was revised and increased to $30,000.

Subsequently it was found that part of the spit off Stage Neck was ledge, instead of loose rock and gravel, and in 1888 the estimate was again revised and made $44,000.

The following appropriations have been made:

August 5, 1886	$15,000
August 11, 1888	10,000
September 19, 1890	10,000

The total expenditures up to June 30, 1891, have been $30,972.58. With these expenditures the following work has been accomplished:

Part of the shoal at the entrance to the harbor has been removed by dredging and rock excavation to a depth of 10 feet at mean low tide, thereby increasing the width of the channel at the narrowest point from 90 feet to about 150 feet. A part of the shoal in the upper part of the harbor has also been removed by dredging to the same depth, increasing the width of the 10-foot channel at that point about 100 feet.

The expenditures during the fiscal year ending June 30, 1892, were $4,027.42, which were chiefly for liabilities incurred during the previous fiscal year. No additional work was done during the last year, as the available funds had been exhausted.

The improvement is in the collection district of York. The nearest light-house is Cape Neddick, 3 miles distant.

Money statement.

July 1, 1891, balance unexpended	$4,027.42
June 30, 1892, amount expended during fiscal year	4,027.42
Amount appropriated by act approved July 13, 1892	9,000.00

COMMERCIAL STATISTICS.

[The statistics of trade for 1891 are furnished by the collector of customs.]

	Tons.		Tons.
Bricks	3,500	Hay	300
Coal	400	Lime	150
Farm produce	100	Wood	800
Fish and oysters	100		
Grain	500	Total	6,350
General merchandise	500		

The tonnage as thus given is about one-third that shown in the annual report of 1891.

Number of vessels arriving in calendar year 1891.

Sailing vessels drawing 10 feet or more	10
Sailing vessels drawing less than 10 feet	10
Barges and flatboats from 100 to 200 tons each	12

A 20.

IMPROVEMENT OF HARBOR AT PORTSMOUTH, NEW HAMPSHIRE.

The harbor and river act of 1878 directed that a survey be made of Portsmouth Harbor, New Hampshire, with a view to its improvement. The survey was made the same year and a report submitted December 12, 1878. The following project for the improvement of the harbor was recommended:

1. To close by means of a rubblestone breakwater the channel between Great Island and Goat Island, so as to prevent the strong currents of flood tide from passing through that channel, as by them vessels in going up the harbor had often been thrown upon Goat Island ledge, which projects far into the channel, here very narrow.
2. The removal of Gangway Rock, which was in the channel between South Beacon Shoal and the navy-yard, to a depth of 20 feet at mean low tide.
3. The removal in part of the ledge at the southwest point of Badgers Island, upon which vessels were liable to be and often have been thrown in coming down the harbor on ebb tide.

The estimated cost of the project was $150,000.

The first appropriation was made in 1879, and work on the project was begun the same year. The first work done was the construction of the breakwater, which was completed in November, 1880. The removal of Gangway Rock was completed in 1888.

In 1889 the project was amended so as to provide for the removal of a small part only of the ledge at Badgers Island, but to a depth of 18 feet instead of 10 feet. The removal of all that was deemed necessary of this ledge was completed in 1891, thus completing all the work contemplated for the improvement of the harbor.

The river and harbor act of 1890 made an appropriation of $13,000 for the removal of a ledge known as Pier Rock. This work also was completed in 1891.

The following appropriations have been made:

March 3, 1879	$10,000	August 11, 1888	$15,000
June 14, 1880	25,000	September 19, 1890 (for removal of Pier Rock)	13,000
March 3, 1881	20,000		
August 2, 1882	17,000		
July 5, 1884	20,000	Total	135,000
August 5, 1886	15,000		

The total expenditures up to June 30, 1891, have been $113,850.94. These expenditures have resulted in making the navigation of the harbor less dangerous than formerly.

The expenditures for the year ending June 30, 1892, have been $14,569.55.

All contemplated improvements for this harbor having been completed, no further appropriation is needed.

Portsmouth is a port of entry. The light-houses are the harbor light at Fort Constitution, and Whale Back, at the entrance. The navy-yard at Kittery, Me., is on the east side of the harbor.

Money statement.

July 1, 1891, balance unexpended	$21,149.06
June 30, 1892, amount expended during fiscal year	14,569.55
July 1, 1892, balance unexpended	6,579.51
July 1, 1892, outstanding liabilities	1,972.12
July 1, 1892, balance available	4,607.39

A 21.

IMPROVEMENT OF BELLAMY RIVER, NEW HAMPSHIRE.

The Bellamy River to the head of navigation is a tidal branch of Great Bay, which empties into the Piscataqua River at Dover Point, 4 miles above the bridge at Portsmouth, N. H. At low water the channel of the river is too shoal for any navigation, except for a short distance from its mouth. The distance over which improvements are projected is about 2½ miles.

A survey was made of the Bellamy River in 1887, and a project of improvement suggested, at an estimated cost of $28,000, which was increased in 1891 to $35,000. The project is to secure a channel 50 feet wide, and 5 feet deep at mean low tide, from the mouth of the river up to Sawyer's Mill at Dover. The rise and fall of tide being about 7 feet a high-water navigation of 12 feet will be secured.

The above project was adopted in 1888 and its execution is now in progress.

The following appropriations have been made:

August 11, 1888	$10,000
September 19, 1890	10,000

The expenditures up to the close of the fiscal year ending ending June 30, 1891, have been $10,111.52. These expenditures have resulted in giving a channel from the mouth of the river up to about 1 mile above Roberts's brickyard, 50 feet wide, and 5 feet deep at low tide. In other words, about 1 mile was added to the navigable part of the river.

The expenditures during the fiscal year ending June 30, 1892, have been $8.82. This expenditure has not added to the facilities of navigation, but a contract has been made for continuing the dredging from the point where it was stopped the year previous. The work provided for under this contract will add about three-fourths of a mile more to the navigable part of the river.

There is no trade on the river at present beyond the brickyard near which the first dredging was begun, but it is thought that the improvement of the river in the upper part will develop the manufacture of bricks, an extra good quality of which, it is reported, can be made here and it will also enable coal and other mill supplies to be shipped to Sawyer's Mill and the western part of Dover at a less cost than at present.

Money statement.

July 1, 1891, balance unexpended		$9,888.48
June 30, 1892, amount expended during fiscal year		8.82
July 1, 1892, balance unexpended		9,879.66
July 1, 1892, outstanding liabilities	$325.00	
July 1, 1892, amount covered by uncompleted contracts	9,000.00	
		9,325.00
July 1, 1892, balance available		554.66
Amount appropriated by act approved July 13, 1892		7,500.00
Amount available for fiscal year ending June 30, 1893		8,054.66
Amount (estimated) required for completion of existing project		7,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		7,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

A 22.

IMPROVEMENT OF COCHECO RIVER, NEW HAMPSHIRE.

The Cocheco River is a branch of the Piscataqua, which empties into the sea at Portsmouth, N. H. Dover is the head of navigation and here the mean rise and fall of tides is about 6.75 feet.

From Dover to the lower narrows a distance of about 1½ miles, the river was much obstructed by bowlders, ledges, and shoals, the depth of water being only from 6 inches to 2 feet at mean low tide. Appropriations amounting to $10,000 were made as early as 1836 and 1837 "for deepening the channel of the Cocheco branch of the Piscataqua leading in to Dover Harbor," but the records do not show what work was accomplished.

The first regular project for the improvement of the river was based on an examination made in 1870 and consisted in making a channel not less than 40 feet wide and 4 feet deep at mean low tide from the lower narrows up to Collins' Wharf, at the head of the upper narrows. The estimated cost of the project was $45,000.

Subsequently more accurate and extended surveys having shown the practicability and importance of extending the improvement up to Packet's Landing and thence to make a channel 2 feet deep at low tide, corresponding to 9 feet at high tide, and a width of 30 feet, up to the bridge at the head of navigation, the estimate was increased to suit the latter project to $85,000. This sum was appropriated between 1871 and 1878 and by 1879 all the improvements at that time contemplated were completed.

These improvements opened up a large commerce employing large vessels where formerly flatboats had been used. Owing to the abrupt turns, however, in the channel at the lower narrows these vessels had difficulty in passing that place. The larger vessels that came into use required a wider and deeper channel. A new project was therefore adopted providing for making a cut-off channel through Alley's Point, with straight connecting channels above and below, and widening to 60 feet and deepening to 5 feet the existing channels through Trickey's and Clements Point Shoals; $28,000 were appropriated and expended in making the "cut-off" through Alley's Point. The other work of blasting and removing rock and dredging in the upper portions of the river was estimated to cost $47,000 more. This second project was completed in 1888.

The act of August 11, 1888, ordered another survey to be made of the river. The report of this survey is dated December 14, 1889. The large increase in trade seemed to justify still a further improvement of the river, and accordingly a new project was submitted, suggesting an improvement that looks to obtaining a channel depth of 7 feet, increased to 7½ feet in rock, the channel to have a minimum width of 50 feet where confined in rock, increasing to 60 and 75 feet where the material is less expensive to remove. This last project is estimated to cost $175.000.

The following appropriations have been made for the improvement of this river:

July 4, 1836	$5,000	June 18, 1878	$6.000
March 3, 1837	5,000	August 2, 1882	28,000
March 3, 1871	10,000	July 5, 1884	28,000
June 10, 1872	10,000	August 5, 1886	10,000
March 3, 1873	10,000	August 11, 1888	9,000
June 23, 1874	10,000	September 19, 1890	25,000
March 3, 1875	25,000		
August 14, 1876	14,000	Total	195.000

The total expenditures on the improvement of the river up to June 30, 1891, have been $170,215.29. These expenditures have resulted in giving a channel through the rocky bed of the river 5 feet deep, and 40 feet wide in the narrowest parts, where before the depth was only from 6 inches to 2 feet.

The expenditures for the fiscal year ending June 30, 1892, have been $24,188.83. The upper end of the channel at Dover has been deepened to 7 feet at mean low tide, for a length of 1,200 feet, with widths varying from 100 to 140 feet. Portions of the channel above and below Clements Wharf of a total length of 600 feet have also been dredged to the same depth.

The improvements in the navigation of the Cocheco have been of great benefit to the people of Dover and the vicinity. In the item of coal alone, it is reported that not less than 35,000 tons are supplied annually at a saving of 50 cents per ton, which could not have been done had no improvements been made.

Money statement.

July 1, 1891, balance unexpended	$24,784.71
June 30, 1892, amount expended during fiscal year	24,188.83
July 1, 1892, balance unexpended	595.88
Amount appropriated by act approved July 13, 1892	15,000.00
Amount available for fiscal year ending June 30, 1893	15,595.88
Amount (estimated) required for completion of existing project	135,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

Receipts and shipments.

Articles.	1890.	1891.
	Tons.	*Tons.*
Bricks		40,056
Coal		26,656
Cement, lime, and plaster		1,810
Iron		390
Lumber		1,500
Phosphates		150
Sand, molding		100
Total	40,000	70,662

Number of vessels arriving in calendar year 1891.

Sailing vessels from 400 tons to 500 tons each	32
Sailing vessels of less than 400 tons each	71
	103
Tugs plying on the river	3
Barges for lightering vessels drawing above 11 feet	1

A 23.

HARBOR OF REFUGE AT LITTLE HARBOR, NEW HAMPSHIRE.

At the instance of members of the Marine Society, and the board of trade, and other citizens of Portsmouth, a survey of this harbor was made in 1882 by Col. George Thom, Corps of Engineers. The improvement desired at that time was to have the channel of entrance opened to a depth of 9 feet at mean low tide, for a width of 100 feet, and to have the inner basin enlarged to a width of 300 feet for a length of about 700 feet, and the dredged channel and basin protected by a rubblestone breakwater. The estimated cost of the project was $33,000.

The act of Congress of July 5, 1884, directed a preliminary examination and survey to be made with a view to its improvement as a harbor of refuge. This examination was made in the latter part of the year 1884, and an enlarged project submitted for the improvement, the estimated cost of which was $150,000. The former project was not regarded by the district engineer as sufficient to accomplish satisfactory results, and the latter he regarded as too costly to justify the Government in undertaking it. The former project, however, was adopted in 1886, and its execution entered upon.

In 1887 the engineer recommended that the project be enlarged, as the old project did not seem to meet the needs of those interested. A new project was therefore suggested, providing for the construction of two breakwaters, one on the north side and the other on the south side of the entrance, and the dredging of an anchorage behind them of about 49 acres to a depth of 12 feet at mean low tide. The estimated cost of the enlarged project was $235,000.

The act of 1888 made an appropriation for the work of $20,000, on the enlarged plan. Before the improvement was undertaken the depth of water in the harbor was only about 6 feet at low tide, and the anchorage was small in area and exposed to the full force of the sea, which is heavy when the winds are strong from the northeast. The object of the improvement is to form a harbor of refuge for small coasters and other vessels that get caught outside and are unable to get into the harbor of Portsmouth on account of the strong ebb tide which sets out to sea. It is said that a number of wrecks have occurred which need not have happened if such a harbor had been in existence.

The following appropriations have been made:

August 5, 1886	$10,000
August 11, 1888	20,000
September 19, 1890	40,000

The total expenditures up to June 30, 1891, were $33,442.44. The results accomplished up to that date were not great, being only the dredging of a part of the area intended for anchorage ground under the new project, and the partial construction of the breakwater on the south side of the entrance.

The expenditures in the fiscal year ending June 30, 1892, have been $8,980.39. This has all been applied to the partial construction of the south breakwater.

A contract was made with Thomas A. Rowe, of Newton, Mass., for the construction of the south breakwater and a beacon on the end of it. Under the terms of the contract he was authorized to use a lot of blasted ledge which lay on the shore in front of Fort McClary. After this material had been exhausted, which was the case after he had taken 13,502 tons of it, the contractor declined to go on with his contract, claiming that he had been given to understand that all the stone could be obtained from Fort McClary. Under the circumstances it became necessary to annul the contract, which was done in accordance with its terms, in May, 1892.

The work was readvertised under date of May 19, 1892, and in response thereto three bids were received, that of George Willett Andrews, of Biddeford, Me., at $1.11 per ton, being the lowest. The contract was awarded to him.

There is no commerce, properly considered as such, in Little Harbor. The work is intended as a harbor of refuge, and will doubtless be used only in case of necessity by small coasters who can not reach Portsmouth Harbor in northeasterly storms.

Money statement.

July 1, 1891, balance unexpended		$36,557.56
June 30, 1892, amount expended during fiscal year		8,980.39
July 1, 1892, balance unexpended		27,577.17
June 1, 1892, outstanding liabilities	$50.00	
July 1, 1892, amount covered by awarded contracts	26,640.00	
		26,690.00
July 1, 1892, balance available		887.17
Amount appropriated by act approved July 13, 1892		30,000.00
Amount available for fiscal year ending June 30, 1893		30,887.17
Amount (estimated) required for completion of existing project		135,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for construction of breakwater at Little Harbor, New Hampshire, June 18, 1892.

No.	Name and address of bidder.	Quantity of stone, 24,000 tons.	
		Price per ton.	Amount.
1	Thomas Liddle, Boston, Mass	$1.24	$29,760
2	John F. Hamilton, Portland, Me	1.49	35,760
3	George Willett Andrews, Biddeford, Me	1.11	26,640

Contract has been awarded to George Willett Andrews.

A 24.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

During March, 1892, the lime-laden schooner *Isabel Alberto* was sunk in the southern part of Rockland Harbor, Maine, constituting an obstruction to navigation. An allotment of funds, under the act of June 14, 1880, has been made, and proposals have been invited for the removal of the wreck.

During December, 1891, the schooner *Huntress* was sunk off Browneys Island, to the southwestward of Moosabec Reach, Maine. The wreck endangers navigation, and steps have been taken looking to its early removal.

A 25.

PRELIMINARY EXAMINATION AND SURVEY OF PENOBSCOT RIVER, MAINE.

[Printed in House Ex. Doc. No. 37, Fifty-second Congress, first session.]

Office of the Chief of Engineers,
United States Army,
Washington, D. C., December 9, 1891.

Sir: I have the honor to submit herewith copy of reports dated March 21 and November 28, 1891, respectively, upon preliminary examination and survey, with three maps,* of Penobscot River, Maine, made by Lieut. Col. Jared A. Smith, Corps of Engineers, in compliance with provisions of river and harbor act approved September 19, 1890.

The works of improvement on Penobscot River proposed in the project submitted are, with estimates of cost, as follows:

1. Improvements near Bangor, Me:		
Widening channel 60 feet on Brewer side and deepening two areas near ferry landings	$15,280	
Removing top of small ledge in front of harbor line off Bacons Wharf	200	
Contingencies and engineering expenses	1,520	
		$17,000
2. Construction of two jetties near Crosby Narrows		20,000
3. Construction of three jetties at High Head and Frankfort Flats, between Winterport and Bucksport, Me		165,000
Total		202,000

---

*Not reprinted; printed in House Ex. Doc. No. 37, Fifty-second Congress, first session.

In case that an appropriation is made for the improvement of Penobscot River the question of construction of jetties or deepening the navigable channel by dredging should have further consideration.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. L. A. GRANT,
Acting Secretary of War.

PRELIMINARY EXAMINATION OF PENOBSCOT RIVER, MAINE.

UNITED STATES ENGINEER OFFICE,
Portland, Me., March 21, 1891.

GENERAL: In compliance with requirements of section 17 of river and harbor act approved September 19, 1890, communicated in Department letter of September 20, 1890, I have the honor to submit the following report of an examination of the Penobscot River, Maine:

During the past five years I have visited various points on the Penobscot River, with special reference to ascertaining its commercial interests and necessities, and on the 6th and 7th of November, 1890, I visited Bangor and Bucksport to obtain further information for this report.

As nearly as can be ascertained by the means at my disposal, the annual freight tonnage on the Penobscot River is largely in excess of 2,000,000 tons.

This is a greater tonnage than is found on any river of our Pacific coast. Only six rivers on our Atlantic and Gulf coast have a larger tonnage, and five of those include parts or all of the harbors of New York, Philadelphia, Baltimore, Norfolk, and New Orleans.

The city of Bangor, which is near the head of tide water on the Penobscot River, is at the head of navigation for steamboats and sail vessels, though the river is, in fact, legally a navigable stream, and is used as a water highway for rafting logs from points much farther in the interior of the State.

The commercial statistics of the river cover only the freights from and below Bangor to the head of Penobscot Bay at Fort Point, a distance of 27 miles by the channel, though the entire distance over river and bay to the coast headlands is about 60 miles.

The Penobscot River thus forms a most important communication with the interior of the State. At Bangor it intersects the Maine Central Railroad, which crosses the State to the Province of New Brunswick.

From these facts it is my opinion that the river is amply worthy of improvement.

The improvements required do not seem extensive or disproportionate when the importance of the navigation is considered.

Various surveys of portions of the river have been made with a view to ascertain the nature and extent of obstructions which should be removed.

By act of March 2, 1829, an appropriation of $300 was made for a survey of the channel from Whitehead to Bangor, but no improvements were undertaken until subsequent to the act of July 11, 1870, by which the sum of $15,000 was appropriated for the improvement of the Penobscot

River at Bangor and below. Thirteen appropriations of an aggregate amount of $308,000 have been made for the improvement of this river.

The principal results have been the enlargement and straightening of the channel at and near Bangor, so as to give a width of not less than 300 feet, having a depth of 11 feet at extreme low-water or about 14 feet at ordinary low tides.

Also the removal of the middle ground in Bucksport Harbor, the widening of the channel near Crosbys Narrows, and deepening and straightening the channel at Frankfort Flats below Winterport.

These improvements involved the removal of several extensive ledges of solid rock, the breaking up and removal of many large bowlders, and a large amount of dredging.

The works near Crosbys Narrows, and between Bucksport and Winterport, are, however, incomplete; it also appears that some bowlders and logs still remain, or have recently been dropped or torn from the bottom by heavy anchors in the harbor of Bangor, causing obstructions which should be removed.

The projects hitherto submitted for improving the river near Crosbys Narrows, and between Bucksport and Winterport, for which estimates were submitted in my last annual report, are thought to be sufficient for all present necessities at those places. (Report Chief of Engineers, 1890, page 434.)

The experiences between Bucksport and Winterport indicate that the only method by which a good channel can be maintained in that part of the river is by contraction works, essentially as recommended in my report of January 11, 1888, and December 11, 1888. (See Report of Chief of Engineers, 1889, page 516, and map opposite.)

In order to ascertain the exact extent and probable cost of clearing obstructions from the river channel at Bangor, a survey will be required for which the estimated expense is $300.

Very respectfully, your obedient servant,

JARED A. SMITH,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

SURVEY OF PENOBSCOT RIVER, MAINE.

UNITED STATES ENGINEER OFFICE,
Portland, Me., November 28, 1891.

GENERAL: In compliance with instructions in Department letters, dated September 20, 1890, and March 24, 1891, I have the honor to submit the following report upon a survey of the Penobscot River, Maine, including a project and estimate of the cost of improvements considered proper to be made.

So far as I have been able to ascertain, the object of the requirement for an examination or survey of the Penobscot River, was to obtain information regarding the necessity for further improvement of the river near Bangor, and at, or near Stern's Mill, about 3 miles below. The maps were already sufficient, save to note whether any changes had occurred in the channel at Bangor, and the survey was therefore limited to that part.

Climatic conditions, such as ice of winter, freshets in the spring, lumber and numerous vessels in the way in the earlier part of the season, and the necessity for making the survey with great economy upon the limited allotment, compelled me to defer the survey until the most favorable conditions could be obtained, which was early in October, 1891.

Mr. A. C. Both, assistant engineer in this office, was detailed to make a survey and maps of the part of the river which extends along the front of the wharves and forms the harbor of Bangor and Brewer.

Attention is invited to the copy of Mr. Both's report, which is appended.

The improvements recommended by Mr. Both are, that the channel be widened 60 feet by dredging on the Brewer side; that two small areas be deepened near the ferry landings, and that the top of a small ledge, now in front of harbor line off Bacon's Wharf, be removed.

The improvements recommended by Mr. Both have been well considered and are approved.

A very interesting point, developed by Mr. Both's survey, is the change in channel produced by the upper wharves at High Head.

The new wharves form contraction works and the change in the channel is entirely produced by the consequent scour. This point is clearly shown upon sheet No. 1 of maps accompanying this report.

The material which was formerly dredged from the harbor of Bangor, to afford a channel width of 300 feet, having a depth of 11 feet at extreme low water, was deposited near the shore at a short distance above Crosbys Narrows. The material consisted largely of coarse gravel and stones, mixed with a hard marl or mud, the whole forming a mass which would not sensibly scour away by the current.

The deposit, therefore, contracted the wet section of the river at that place. The result has been somewhat unexpected. The shoaling above Crosbys Narrows was caused entirely by deposits of mill waste, principally edgings, small sticks, and some slabs.

While it was apparent that a quickened current would prevent further shoaling, it was not at all clear that it would perceptibly improve the channel by removing a tangled mass of mill waste.

For explanation of this part of my report I refer to map on sheet No. 2. The deposits of dredged material, as above stated, extended along the shore a distance of about 2,000 feet, making a considerable contraction of the cross section of the river. The river has, however, readjusted its conditions by widening the channel, which has a depth exceeding 12 feet at extreme low water. The widening is, in places, more than 200 feet—more than doubling the capacity of the original channel. The effect extends over a distance of about 3,000 feet, and an average width of perhaps 150 feet. Over much of the area thus scoured away the deepening has been as great as 10 feet.

Immediately below the part which has been widened by scouring is an extension of the same shoal, the removal of which, by dredging, has been a part of the project for improvement adopted in 1884.

The area has been dredged as shown upon the map, sheet No. 2, but it is found to refill, and a portion of it has recently been redredged.

The experience related indicates that the only method of obtaining a permanent improvement in the channel width at this place is by contraction works. Material dredged is, of course, unsuitable to make the contraction, and for this reason I recommend the construction of two small jetties of rough stone, as shown in plan and section upon the map.

The estimated cost of the jetties will be included with other estimates at the end of this report.

I can not leave this part of the river without referring to the proposed removal of the point of shoal near Stern's Mill, as indicated in the river and harbor act approved September 19, 1890.

In July, 1890, the question of dredging at Stern's Mill was referred to me for report, and under date of July 31, 1890, the report was submitted with an explanatory map. The report has been included in my annual report for year ending June 30, 1891, and as it is of much importance in the matter here discussed, especial reference is made thereto.

I also ask especial reference to map on sheet No. 2 accompanying this report.

The facts set forth in the report mentioned convinced me fully that the shoal was not at all in the way of the general navigation of the river. Nearly all the large sail vessels are taken up and down the river by steam tugs, and the benefit to that class of vessels from widening the channel at one limited place would be too small to be appreciable. On the other hand, it is apparent that as a contraction of the cross section in the vicinity has largely increased the navigable width, the converse is very likely to obtain, so that a sudden widening of the channel beyond what natural conditions have been able to maintain is coupled with the probability that a shoaling will occur to a greater or less extent and that an injury will thus result instead of a benefit.

It will be observed that this widening is on one side of a practically straight reach 8,000 feet long, where natural conditions do not maintain a channel more than one-half as wide as will be produced in front of Stern's Mill by the dredging now under contract.

The petition for the removal of this shoal, which is entirely of sawmill waste, originated in the office of the proprietors of the adjacent sawmill, who are also proprietors of some large ice houses.

It may be incidentally remarked that the area available for cutting ice will be sensibly increased by removing the shoal, as a part of it projects above low water.

The river and harbor act approved September 19, 1890, appropriated for "Improving Penobscot River, Maine, continuing improvement and for dredging near Stern's Mill, $25,000."

* * * * * * * *

All the obstructions which have thus far been brought to my attention on the Penobscot River below Bangor are due entirely to mill waste and refuse.

Much of this waste has doubtless been deposited from the banks of small tributaries which are not considered navigable and has been carried down in freshets to the navigable waters of the Penobscot.

The worst obstruction at present in the river is the shoal at High Head, near Bucksport. (See sheet No. 3.)

The channel depth is very uncertain, owing to the material composing the bar, which is almost entirely of sawdust. The extreme variations in the low-water depth shown by maps in this office is about 9 feet.

The bar at Frankfort Flats is nearly all of the same kind of mill refuse. The results of dredging in that bar indicate very conclusively that the fluctuations are so great that the only reliable method of maintaining a permanent and satisfactory channel is by introducing some kind of contraction work to accelerate or modify the currents.

The situ amount of material above the grade of 22 feet below mean low water in the channel which was dredged may be summarized as follows:

	Cubic yards.
In September, 1887	134,057
In August, 1889	72,593

In August, 1889, dredging was commenced, and, except a suspension for winter, was continued until July 24, 1890.

The dredging was to an average depth of about 2 feet below grade, and the amount removed was 152,376 cubic yards, measured in scows.

Immediately after the work was completed a close survey showed about 19,500 cubic yards more material in the channel than there was when work was commenced.

On October, 1891, another close survey of the same channel showed still further filling, so that the amount above grade was 48,407 cubic yards more material than in the month before dredging commenced.

The material has been found of a kind so easily moved that the full amount of contraction works planned in 1888 does not seem to be required. (See map opposite page 516, Report of Chief of Engineers, 1889.)

A new project is therefore submitted as the result of several years' experience and study of the situation at Frankfort Flats and at High Head.

It should be stated that as the channel at Frankfort Flats is at present far better than over the bar at High Head, it gives no present trouble, because any vessel which can pass over the bar below will, of course, have no special difficulty where the channel is deeper.

The project now submitted for accomplishing the result indicated is, first, to construct the jetty C of rough stone from the shore to the contour of 12 feet depth.

This jetty will deflect the strong flood-tide currents which now sweep obliquely across the channel, and will increase the ebb currents at that point.

Second. For the bar at High Head, to construct two small jetties, A and B, of rough stone, as shown upon the map, sheet 3.

The estimated cost of the entire project here submitted for the Penobscot River is as follows:

For widening channel at Bangor and dredging at ferry landings:		
47,600 cubic yards dredging, at 30 cents	$14,280	
200 cubic yards bowlders, at $5	1,000	
Removing small ledge in front of harbor line at Bacon's Wharf.	200	
Contingencies and engineering expenses	1,520	
Total for improvements near Bangor		$17,000
Second. For two jetties near Crosbys Narrows:		
Jetty I, 9,667 tons stone (2,000 pounds).		
Jetty II, 8,694 tons stone (2,000 pounds).		
Total, 18,361 tons stone, at $1 per ton	18,361	
Engineering and contingencies, say	1,639	
		20,000
Third. For three jetties between Bucksport and Winterport:		
Jetty C, 78,019 tons of stone.		
Jetty B, 40,044 tons of stone.		
Jetty A, 82,825 tons of stone.		
Total, 200,888 tons of stone, at 75 cents	150,666	
Contingencies of engineering, etc	14,334	
Total		165,000
Total of estimates		202,000

My preliminary report, submitted March 21, 1891, contained a general statement regarding the situation of the river, its tonnage, and commercial importance.

For the year 1890 a statement of the exports from the river, procured from entirely reliable sources, but of necessity very incomplete, showed export shipments of ice, lumber, granite, bricks, and miscellaneous productions, amounting to 1,039,521 tons, carried in vessels. In addition to this large quantities of lumber are towed in rafts. The imports are nearly one-third as much as the exports, and the number of passengers by steamboats amounts to many thousands annually.

Vessels drawing 21 feet or more arrive at and depart from Bangor at high water. In order to do this, the points below must be passed at lower stages of the tide, and to prevent delay and embarrassment to the large business of the river, the points which must necessarily be passed at low water should give as great a depth at that stage as is needed at Bangor when the water is high. For these reasons a channel 22 feet deep is required at Frankfort Flats and High Head.

Maps in three tracings, already mentioned, are forwarded separately to accompany this report.* As the maps are essential to a full understanding of the discussion here submitted, I have specially to ask that they may be included in the printed report.

Very respectfully, your obedient servant,

JARED A. SMITH,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

REPORT OF MR. A. C. BOTH, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Portland, Me., November 17, 1891.

COLONEL: I have the honor to submit the following report upon an examination of Bangor Harbor, Maine, required by river and harbor act dated September 19, 1890. The survey was made in the first part of October. The soundings shown on the accompanying map were all located accurately by transit angles from shore. They refer to the level of extreme low water, which is about 3 feet below the level of the average low-water stage of the river.

From these soundings it is apparent that the present condition of the harbor bottom has not materially changed since the time the improvements were first commenced in 1870. The principal shoaling of any consequence (from 0 to 2 feet) over areas formerly dredged to 11 feet at extreme low water, has taken place in front of and below Smith, Morse & Co.'s wharf, as far as the ferry slip in Brewer. The condition for the deposit of matter in this locality is very favorable. The main current of the river here sweeps along the Bangor shore, causing a large eddy to form under the lee of Smith, Morse & Co.'s wharf, and as far down as the ferry slip. The material which is thus unavoidably deposited here consists entirely of fine drift stuff and sawdust, and forms no dangerous obstruction to the anchorage of smaller coasting vessels, which are mostly anchored in this locality.

A very slight shoaling (a few tenths of a foot) has taken place in the easterly half of the channel, between the wharf of the Dirigo steam sawmill and McGilvery's marine railway wharf. This shoaling, however, can be entirely prevented by a proper decrease of the cross section of the river at this place. The dredged channel otherwise has kept its depth of 11 feet at extreme low water admirably well, and has proved of great value to the shipping in Bangor harbor.

In order to make this examination as thorough as possible, I requested all interested parties, having knowledge of any obstruction to the easy and safe navigation of the harbor to inform me thereof, so that they might be included in the examination. Through the courtesy of the three local Bangor papers, the request was published at the time.

The only direct response to this notice came from Mr. Bacon, coal merchant, who informed me that a small point of ledge in front of his wharf had given him considerable trouble, by damaging many vessels lying at his wharf. This small point of ledge escaped detection during a close survey of this locality made by me in 1872. It is located 210 feet below lower corner of the Bangor and Boston steamer wharf, and 36 feet outside of the face of Mr. Bacon's Wharf (or 11 feet outside of the established harbor line). Its shoalest has 5.6 feet of water on it at extreme low water, and is about 4 feet wide and 6 to 7 feet long, and slopes down to the level of the surrounding bottom.

I recommend that this obstructien be removed to the depth of surrounding bottom, which is 8 feet at extreme low water.

The improvements made so far in Bangor Harbor have proved of great benefit and are highly appreciated. The general desire for more room, however, is expressed by every one with whom I conversed upon this subject.

---

*Not reprinted; printed in House Ex. Doc. No. 37, Fifty-second Congress, first session.

To meet this demand for increased anchorage facilities it is proposed to widen the present channel by excavating a strip 60 feet wide along the entire length of channel at its easterly or Brewer side, thus making the channel 360 feet wide.

This would require the removal of 46,000 cubic yards of material, measured in scows. The material consists mostly of coarse gravel and rocks.

While dredging under former contracts quite a number of large bowlders were met with, and for this work it is estimated that 200 cubic yards of such rocks may be found, the removal of which is estimated at $5 per cubic yard.

It has also been represented to me that the steam ferryboat which plies between Bangor and Brewer is very frequently detained at time of low water from reaching the floating platforms at either side, to the great annoyance of the passengers.

Three hundred thousand passengers were carried across by this ferry in 1890. A very small amount of dredging in front of these landings would facilitate the prompt landing of passengers, and certainly would be appreciated by the thousands who are often kept within 10 or 20 feet of the landing waiting for the tide. The removal of about 800 cubic yards of material, mostly old slabs and edgings, in front of either platform, to a depth of 4 feet at extreme low water, will give ample facilities to the ferryboat during time of low water to make its trips without interruption, which is necessary to accommodate the traffic.

In comparing the contour lines of survey of 1872 with those of the present survey, in the vicinity of Fred Ayer's ice-house wharf, opposite High Head Wharf, it will be found that the 11-foot contour of 1872 has receded on an average 100 feet toward the Brewer shore (and the low-water line in the same ratio).

Thus the channel at this place is now over 400 feet wide. This great scour being the direct result of the building of the "Upper High Head Wharf" and its influence upon the direction of the current, it shows conclusively that by judicious contraction of the cross section of the river all the improvements may not only be kept entirely clear of deposits, but may gradually be considerably increased in width and depth.

As it is evident that the shoaling in the dredged channel off and below the Dirigo Wharf is caused by the abnormal width of the river at this place, it is suggested that the harbor line be placed some 200 feet east of the present location, and that the material to be excavated from the east side of the channel be deposited behind it from Greens Pier Ledge down toward High Head Wharf. This suggested new location of the harbor line will in no way decrease the capacity of the harbor, as this part of the river, having a very hard and rocky bottom, is seldom used as anchorage for vessels. In former years this area was used by a great number of small coasting vessels, which were anchored side by side and at right angles to the axis of the river and loaded there.

With the employment, generally, of larger and deeper draft vessels, this area has become, so to say, useless. By partly filling it with the excavated material, which consists mostly of coarse gravel and rocks, being an excellent and permanent material for filling, the main channel will thereby be kept entirely clear of any deposits.

Since the survey of the Penobscot River from Bangor to Crosbys Narrows, which was made in 1872–'74, a large number of ice houses and other establishments, with the necessary wharves and piers, have been built on this part of the river.

These latter doubtless have caused considerable changes in the formation of the river bottom by contraction of cross section and by diversion of the currents. It would therefore seem appropriate to have a survey made from High Head wharves to Stern's Mill (a distance of about 2½ miles), to locate all the new wharves, piers, and other structures, and to make a sufficient number of soundings to clearly define changes and the location of the channel.

The following estimate for the proposed improvements is herewith respectfully submitted:

1. Widening and deepening the ship channel in Bangor Harbor, Maine, 60 feet at its easterly edge, 11 feet deep at extreme low water, will require the removal of 47,600 cubic yards of material measured in scows (including 1,600 cubic yards of dredging in front of the ferry landings), at 30 cents per cubic yard	$14,280
2. For removing 200 cubic yards of large bowlders, at $5 per yard	1,000
3. For removal of small ledge in front of harbor line, off Bacon's coal wharf	200
4. Contingencies and engineering expenses	1,520
Total cost of improvement	17,000

Very respectfully, your obedient servant,

A. C. BOTH,
Assistant Engineer.

Lieut. Col. JARED A. SMITH,
Corps of Engineers, U. S. A.

A 26.

[Printed in House Ex. Doc. No. 76, Fifty-second Congress, first session.]

PRELIMINARY EXAMINATION OF KENNEBEC RIVER, MAINE, FROM WATERVILLE TO STEAMBOAT WHARF AT AUGUSTA.

UNITED STATES ENGINEER OFFICE,
Portland, Me., December 12, 1890.

GENERAL: In compliance with instructions in Department letter, dated September 20, 1890, I have the honor to submit the following report of a preliminary examination of the Kennebec River from Waterville to the steamboat wharf at Augusta, Me.

On the 21st of October I went over the entire distance of 16 miles from the dam at Waterville to steamboat wharf at Augusta, and observed the points bearing upon its improvement for navigation.

Leaving Waterville in a rowboat, accompanied by Hon. William T. Haines, secretary of the Waterville Navigation Company, and with a river pilot and a helper as oarsman, the channel was first observed as far as Vassalboro Landing, which is on the east side of the river, somewhat more than 6 miles below Waterville.

Nearly all the channel obstructions are included in this part of the river, and a small boat afforded better opportunities for inspecting the shallow places.

The landing at Waterville is now from a small channel behind a low island, which has been formed below the large cotton mill.

After passing out to the main channel of the river a bar of sawmill waste is found projecting beyond the island.

Descending the river, the water was generally found deep and smooth. I had no means of measuring the width between banks, but judged it to range from 600 to 1,200 feet, the broader places generally being the less deep.

Fort Point Reef, Pettys Rips, Carters Rapid, and Six Mile Fall are all places where the channel is more or less obstructed, apparently by bowlders and small stones in various sizes.

The ripple of the water over large bowlders was noticed in many places in or near the channel.

At one place in the river was a small machine, which the Navigation Company has been employing in removing some of the more annoying bowlders.

So far as can be judged by observing the formations of the banks or by prodding the bottom with a pole the improvement of the channel will not require the removal of solid ledge. This point can be definitely determined only by an examination of the bottom by borings or by driving rods.

At Vassalboro Landing I took passage on the steamer *City of Waterville*, in company with Mr. Haines and others.

There are no obstructions of any great present importance between

Vassalboro and the dam at Augusta, about 10 miles below. The river is, however, dotted with piers which have been built by lumber companies at whatever points suited their convenience for booming logs without reference to any channel for commercial navigation.

At one point the bank on the east side of the river was observed to be "caving in," and thus widening the river, as a result of the increased current thrown against the shore by the piers.

Much of the time in summer the river in places is practically filled with logs, which extend from shore to shore. Many times in passing along the shore I have observed the accumulations of logs, which seemed to cover the water for miles.

In the autumn the amount of logs is naturally reduced to a minimum, and yet on arriving near the dam at Augusta the steamer was unable to reach the lock, owing to the logs which were held by a boom entirely inclosing the approaches.

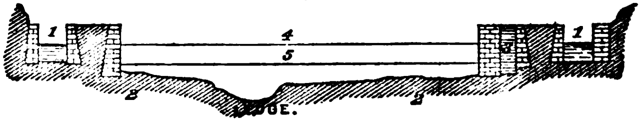
The lumber companies, which have done so much injury to navigation and other interests by the waste from their mills, not only use the river for its legitimate purpose as a public highway for transportation, but use its channel to store and preserve the logs for an indefinite time, until they can be manufactured into lumber or pulp.

The dam at Augusta was built under a charter originally granted by the State of Maine, March 7, 1834. By an act of March 13, 1887, the name of the corporation was changed to the "Kennebec Locks and Canals Company," and the capital stock was limited to $600,000.

The first boat passed through the lock on the 12th day of October, 1837.

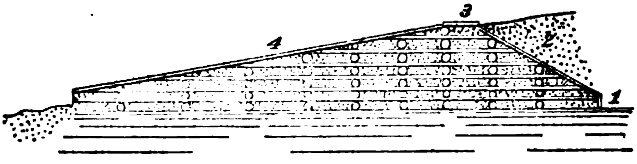
As a description of the dam and lock are of interest in this connection, and as the record should be preserved, I quote the following from "The History of Augusta," published in 1870, by James W. North, pages 579 and 580.

> The dam at this time was 600 feet in length between the abutments, with a base of 127 feet and height of 16 feet above ordinary high water. It was built in the most substantial manner, with cribs of timber bolted and treenailed together and filled with ballast. The upper slope was covered with 5-inch pine plank, jointed; the lower with 5 and 3 inch hemlock plank. The top was covered with stone 8 feet long, secured with iron straps and bolts. The central portion for 60 feet was depressed 20 inches for a sluice way.



LONGITUDINAL SECTION OF DAM.

1. Canals; 2. Gravel bed of river; 3. Lock; 4. Top of dam; 5. High water below dam.



TRANSVERSE SECTION OF DAM.

1. Sheet piling; 2. Upper slope graveled; 3. Stone cap; 4. Lower slope.

> The walls of the lock were of granite, 170 feet in length, its chamber being 101 feet long by 28½ feet wide in the clear, with a single lift. The west wall of the lock formed the eastern abutment of the dam and was 28 feet at the base and 25 feet at

the top. The east and head walls were of corresponding thickness. The face courses of the walls were hammered bed and joint, rabbeted, and laid in cement and the rabbet filled with cement. The floor of the lock was laid with 5-inch pine plank, tongued and grooved, on timbers 15 inches deep. The main gates of the lock and canals were of Chesapeake white oak, with wickets of cast iron. The large stone piers above the dam to protect the lock and abutments were 30 feet square at the base, 25 feet at the top, and 34 feet high, strongly clamped and strapped with iron. The canals on each side of the river were 50 feet wide, carrying 10 feet of water from the level of the top of the dam. The walls were 22 feet high, 7¼ feet thick at the base, and 5 feet at the top. They were finished as far as and including the guard gates, from which sheet piling extended across and 25 feet into each bank and was driven 10 feet below the bottom of the canals. The bank walls, extending about 500 feet above and below the dam, were of the same height as the canal walls, and were 8 feet thick at the base. The upper side of the dam was secured by a sheet of timber piling, tongued and grooved, passing into the western bank and connecting with the piling crossing the lock into the eastern bank. Above this and covering the entire planking of the upper slope was a heavy mass of gravel.

About 25 tons of iron, 75,000 tons of ballast, and 2,500,000 feet of timber were used in constructing the dam, and 800,000 cubic feet of granite on the lock, piers, canal, and bank walls.

At a time peculiarly favorable for measuring the water, when the space through which the river flowed was contracted to 17 feet wide and 24 feet deep, repeated observations were made upon the velocity of the current, to ascertain the quantity of water passing, and at no time was it found to be less than 2,500,000 cubic feet per second. This was in 1837, a year remarkable for the small quantity of water running in all the streams in the neighborhood. The pond formed by the dam covers 1,200 acres. It is 16 miles long, with an average depth of 16 feet. This magnificent water power cost the large sum of $300,000.

The exact lift of the lock is not given, but the height of the dam is sufficient to afford practically a slack-water navigation for 10 miles above, and to reduce the surface declivity and therefore increase the depth over much of the remaining distance to Waterville.

Below the dam the water is quite rapid over a distance of perhaps one-fourth of a mile and the navigable channel is narrow.

The dam furnishes a water power for extensive cotton mills on the west side and for a mill for the manufacture of wood pulp adjacent to the lock on the east side of the river.

The water from the mills returns to the channel at points somewhat below the dam, so that in low stages of the river the channel at the foot of the lock has a smaller depth than would otherwise be found. On the day of my visit the depth in this channel was probably from 5 to 6 feet.

A lock-tender is employed and tolls are charged for the passage of boats.

In February, 1870, the old dam at Augusta was carried away in a freshet and some modifications were doubtless introduced in renewing it. The lock, however, remains essentially as first constructed.

The bridge of the Maine Central Railroad and the highway bridge belonging to the city of Augusta cross the river between the dam and the steamboat landing. The city bridge has recently been entirely rebuilt and some part of one or more of the old piers, as well as some loose stones which have been taken from them, are more or less in the channel way. Some stones, originally intended for use in piers of the railroad bridge, are also in the channel near the east shore. Neither of the bridges are provided with draws, but at present they are not required, because the bridges are sufficiently high to permit the passage of small steamboats underneath, and there is no present demand for vessels with masts to carry freight to points above.

A survey or reconnaissance of the Kennebec River from Augusta to Skowhegan, several miles above Waterville, was made under direction of Colonel Abert, of the United States Topographical Engineers, in the summer of 1826. There are no maps or other record of that survey in this office.

A considerable amount of navigation has at times extended over the river as far up as Waterville, both before and after the construction of the lock and dam.

North's History, already mentioned, states that the steamboat *Waterville*, built at Bath, was running on the river in 1825. In June of that year she took passengers to Portland on the occasion of the visit of Lafayette. The steamer could only run to Waterville when the river was swollen.

The steamer *City of Waterville*, now running upon the river above Augusta, is registered as of 32 tons burden, but its actual capacity is much larger. The boat is 90 feet long and 24 feet wide.

The trips of the steamer have been very seriously impeded and sometimes made quite impracticable by the vast storage of logs already mentioned. Notwithstanding the difficulties the steamer has run most of the time and has carried freight and passengers. I was informed that the running expenses of the steamer have been paid by receipts from passengers only, at rates about one-half those charged by the railroad for equal distances.

The river from Waterville to Augusta is very direct, and its surroundings give it a rare beauty. The west bank rises abruptly to a considerable height and where not too steep, the slope is wooded. The east bank is lower and the adjoining lands, rising more gently, are covered with good farms.

Waterville is the natural head of steam navigation, though Augusta is at the head of tidewater.

It was not practicable to obtain an exact statement of all the articles of freight upon which cheaper rates may be expected by improving the channel for navigation.

In the evening of October 20 I held an informal conference with several representative citizens of Waterville, who assembled in the office of Hon. William T. Haines. The following points were developed:

Waterville is a prosperous business and manufacturing city of 7,500 inhabitants. It is also the seat of Colby University. Other towns and villages within the radius of a few miles and having a common interest with Waterville in obtaining cheaper transportation increase the aggregate population of the communities to more than 26,000.

There are but few rivers in the United States whose tonnage exceeds that of the Kennebec. The latest statistics indicate that the annual freight tonnage on this river below Augusta exceeds 2,500,000 tons. In the freight tonnage statistics the vast amount of lumber floated down in single logs and rafts, both above and below Augusta, is not counted.

The annual consumption of coal sold at Waterville for manufacturing and domestic use, as stated by dealers, is 17,000 tons. Of miscellaneous hardware there is 1,500 tons. In addition to these, nearly the entire consumption of flour, meal, corn and grain, lime, cement, and plaster, groceries, dry goods, clothing, rolled and cast iron, tin, glass, and many other articles, go to make up the freights which would be received by water, or obtain cheaper rates of freight by having a water communication. The total of such freights received may be estimated at 30,000 tons annually.

Exports are comparatively small, but would doubtless be increased with cheaper facilities for transportation. They consist of granite, slate, some lumber, and various agricultural productions. The passenger traffic is also an item of some importance in both directions.

At present a large part of the freight for Waterville and dependent communities is brought to Gardiner or Augusta by water and thence transferred to cars and carried by rail. Freight over the above distance upon coal, when all loading and unloading is done at the expense of consignee, is $1.25 per ton by the vessel cargo, or $1.50 per ton for a single carload. The handling costs 35 cents per ton. Other freights in general occupy more room per ton and the rates are higher.

The probable effect of navigation on freight rates, by rail as well as water, may be surmised from the statement made to me, that freight rates to Bangor, 52 miles beyond Waterville on the same road, are considerably less than to Waterville, where there has hitherto been no adequate competition by boats.

Experience of the past season indicates that coal and other freights, before mentioned, may be readily transported by water, when having a clear channel of say 5 feet minimum depth, at rates which would save an average of not less than $1 per ton on the present cost.

Upon this basis $30,000 per annum would be a moderate estimate of the probable benefits to be expected on the present amounts of business. Doubtless with such rates business would increase, but to what extent is a matter for conjecture only.

After fully considering the subject, it is my opinion that the Kennebec River from Waterville to steamboat wharf at Augusta, Me., is worthy of improvement.

The kind and extent of improvements necessary can only be determined after a complete survey covering the entire distance. It is essential for a full understanding of the subject that the survey should not be abridged, and that it should include differences of level, character of the bottom and banks, and current velocities. To make such a survery and to complete the maps and records will cost $2,500.

Very respectfully, your obedient servant,

JARED A. SMITH,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

SURVEY OF KENNEBEC RIVER, MAINE, FROM WATERVILLE TO STEAMBOAT WHARF AT AUGUSTA.

UNITED STATES ENGINEER OFFICE,
Portland, Me., January 7, 1892.

GENERAL: The harbor and river act, approved September 19, 1890, contains an order for an examination, or survey, or both, of the Kennebec River, from Waterville to the steamboat landing at Augusta, Me. This work was assigned to my predecessor, Lieut. Col. Jared A. Smith, Corps of Engineers. He made a preliminary examination and reported that, in his opinion, the river is worthy of improvement, and on his recommendation a survey was ordered, which survey was made under his direction by Mr. F. S. Burrowes, assistant engineer. The maps of the survey were not completed in time for Colonel Smith to make a report before being relieved from duty in this district, and the work was transferred to me December 3, 1891.

From the report of Mr. Burrowes, appended, it will be seen that the navigation of the Kennebec River between Augusta and Waterville is obstructed at the following places:

At Augusta itself, the head of tide water, and at present the head of navigation, there is a dam and lock. These were built by the State some years ago, but are now the property of a private corporation. There are also two bridges, one belonging to the Maine Central Railroad Company and the other a bridge built by the city of Augusta. There is 28 feet headroom under one of these bridges at high tide, and more than that under the other, but neither is provided with a draw. The dam is about 17 feet high, and the lock has a lift of 15½ feet, the depth on the lower miter sill being 5 feet at ordinary low tide, but less than this at extreme low water. The dam furnishes water power for a pulp mill on the east side of the river and a cotton mill on the west side. The lock is 110 feet long and 28.4 feet wide. At the foot of the lock there is shoal water, the depth in extreme low stages being only 1.7 feet. From thence down to the steamboat landing the depth varies, the available depth for purpose of navigation being about 2 feet at low tide. The low tide referred to is the lowest stage of the river observed at the time of the survey. The water sometimes gets to be at least a foot lower.

Above the dam there is a pool of still water, the depth of which in no place is less than about 5 feet for a distance of 14½ miles, viz, to the foot of Carters Ledges.

The next obstruction is at Carters Ledges, about 3½ miles below Waterville. These ledges extend entirely across the river, but there is a channel about 100 feet wide, and with a depth of 4.4 feet in it at ordinary summer level. The amount of excavation to get 5 feet over this shoal is not large, but it is all ledge and will have to be blasted.

The next obstruction is a small shoal just below Pettys Rips. There is a depth here of 4.1 feet at summer level, and the material to be removed to secure 5 feet consists of bowlders and gravel.

From thence to Pettys Rips there is 5 feet. At the rips the depth is 2½ feet only, the material bowlders and gravel. Here the fall in the river is great and the current rapid. At this place the logging interests and steamboat interests will conflict, as one is certain to interfere with the other.

From Pettys Rips to Fort Point Rips there is full 5 feet, except at one place, where the depth is 4.5 feet, the material on the shoal being bowlders and gravel.

At Fort Point the depth is only 1.8 feet, and in dry seasons it is doubtless not over 1 foot, the material to 5 feet being bowlders and gravel.

A 5-foot navigation would satisfy the demands of those interested in the navigation of the river, and a greater depth can only be secured at a greatly increased cost, as it would necessitate the removal of large quantities of solid rock. The estimated cost of securing a 5-foot navigation from the steamboat landing at Augusta to Waterville, Me., is $45,800.

Whether it should be constructed by the Government is another matter. The State has assumed jurisdiction over the river above Augusta by authorizing the construction of dams across it, and while a lock was built in the one at Augusta, the company owning it is authorized and does charge toll for vessels going through it.

The amount of trade that would be developed is problematical. Colonel Smith estimates the saving in freight at about $30,000 annually. On the other hand, the question would arise whether steamboat navigation would not interfere with logging on the river. This is, after all, the greatest industry.

The river between Augusta and Waterville is sometimes filled with logs, so that navigation would be practically suspended for the time being. The logging industry, it is estimated, has a value of not less than $1,000,000 per annum, from which it will be seen that this industry should not be made to suffer from the proposed improvements. The State has chartered a company that brings these logs down the river and rafts them only after passing Augusta. At the place known as Pettys Rips the channel is narrow, and it is sometimes filled with logs for days at a time.

I am informed that the lock at Augusta is not of sufficient length for the class of boats that would go up to Waterville. To lengthen it so that it would meet the requirements would add $25,000 to the estimated cost of the improvement, making the total $70,800.

I inclose herewith two tracings* showing the survey.

Very respectfully, your obedient servant,

PETER C. HAINS,
Lieutenant-Colonel, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

REPORT OF MR. F. S. BURROWES, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Portland, Me., January 6, 1892.

COLONEL: I have the honor to submit the following report of a survey of Kennebec River, Maine, from Waterville to the steamboat wharf at Augusta:

The survey was begun at Waterville August 3, and completed to Augusta September 19, 1891, the total length of river surveyed being 18 miles. A triangulation was made to cover the entire length of river surveyed and consisted of 114 triangles. The triangulation points, wherever practicable, were marked by drill holes in ledge or large bowlders along the banks of the river, 88 of them being so marked. Each angle was read three times and the angles in each triangle made to balance within one minute or less. Five base lines were measured with a standard steel tape 200 feet long at nearly equal intervals in the length of the survey. The track of the Maine Central Railroad, which follows the river closely, afforded good opportunities for the measurement of the base lines. The shore line between triangulation points was run in by stadia measurement.

The depths were measured either with a graduated rod or with a 9-pound lead on a graduated brass chain, and each sounding was located by intersection with two transits on shore. The depths on the tidal portion of the river, below the dam at Augusta, are referred to the surface of the water at the lowest tide observed during the survey. Above the dam the soundings are referred to the surface of the water at the time of the survey, which was then at ordinary summer level. From the best information I could obtain at that time I should judge there would be about 1 foot less depth on the shoals in the upper part of the river at extreme low-water stages. Bench marks for the reëstablishment of the water surface, to which the soundings have been referred, were marked by drill holes along the banks of the river.

Owing to lack of time, levels were run only from Waterville to the foot of the rapids at Carters Ledges, a distance of 3½ miles, and from the dam to the steamboat wharf at Augusta, a further distance of three-fourths of a mile. Within this total length of 4¼ miles are included all the shoals which seriously interfere with the navigation of the river.

The survey was plotted to a scale of 1:6,000 and two tracings, showing the whole length of the river surveyed, are submitted.

The four worst shoals were also plotted separately to scales of 1:1,000 and 1:2,000, and from these larger charts the estimates have been made.

The tidal portion of the river extends from the steamboat wharf at Augusta to a point 4,000 feet above where there is a dam with a lock at its eastern end capable of passing a boat 90 feet long and 28 feet wide. This dam was built for the purpose of yielding power for manufacturing purposes, which is at present utilized by a large cotton mill on the west and a wood-pulp mill on the east bank. The lock and dam are kept in repair by the company operating the cotton mill, and a toll is charged for the passage of boats through the lock. This company is known as the Edwards Manufacturing Company. The lock is built of cut granite masonry, and is in fairly good condition. From the west side of the lock a timber crib work with its top 8 feet above low tide extends down the river 227 feet. This was built to give a slack-water pool at the entrance to the lock, but as the water from the wheels of the pulp mill is discharged with great velocity directly opposite this structure it fails to serve its purpose.

---

*Not reprinted; printed in House Ex. Doc. No. 76, Fifty-second Congress, first session.

At the time of the survey the surface of low tide at the dam was 3.29 feet higher than at the steamboat wharf. High tide at the steamboat wharf rose 5 feet, and at the foot of the dam only 1.8 feet, thus making the high-water surface nearly level. The lower miter sill of the lock is 5.5 feet below low tide at the foot of the dam, and only 2.21 feet below low tide at the steamboat wharf. The difference in level between miter sills of the lock is 15.39 feet. The top of the dam is 17.11 feet above low tide, and 15.31 feet above high tide at its foot, and 7.22 feet above the level of the upper miter sill of the lock.

One thousand and fifty feet above the steamboat wharf the river is crossed by a wagon bridge, and 850 feet farther up it is crossed by the bridge of the Maine Central Railroad. Neither of these bridges have drawspans. The lower chord of the wagon bridge is 33.4 feet above low tide, and 28.4 feet above high tide. The lower chord of the railroad bridge is 46.86 feet above low tide, and 43.60 feet above high tide. About two years ago the wagon bridge was rebuilt. The old bridge had two spans with one pier near the middle of the river, and the new bridge has three spans with two piers in the river, one on either side of the old central pier. The masonry of this old pier was taken down but the crib-work foundation still remains and there is only 1¼ feet of water on it at low tide. The channel between this old foundation and the new easterly pier has a width of only 75 feet.

From the steamboat wharf to the wagon bridge there is a channel depth of 10 feet or more at low tide. Between the bridges there is a shoal 500 feet long with a depth on it of only 2½ feet at low tide. Just above the railroad bridge there is a shoal 300 feet long with a least depth of 2 feet, and at the entrance to the lock another shoal with a depth of less than 2 feet on it at low tide. The great difference in level of 3.29 feet between low tide at the foot of the dam and at the steamboat wharf of course gives rise to a very strong current. Most of this difference in level is taken up on the shoals above and below the railroad bridge, and the current is so strong at low tide that it is almost impossible to row up in a small boat.

From the dam to Vassalboro, 12 miles above the steamboat wharf at Augusta, the river is simply a mill pond, and has a barely perceptible current. This portion of the river varies in width from 500 feet to 1,100 feet, and has a navigable channel from 10 feet to 30 feet deep. Five miles above Augusta there is a small island in the river known as Five Mile Island. There is, however, a good navigable channel on either side of it. From Vassalboro to the foot of the rapids at Carters Ledges, a distance of 2½ miles, the river shoals rapidly, and there is a navigable channel through this portion of only 6 feet depth. Between the foot of the rapids at Carters Ledges and Waterville, a distance of 3½ miles, the water surface has a slope of 8.63 feet. Most of this slope occurs on the three shoals with which this part of the river is obstructed, and which are known as "Carters Ledges," "Pettys Rips," and "Fort Point Rips." At the time of the survey the current over these shoals was so swift that the only way to ascend them with a small boat was by towing along shore.

Opposite the steamboat landing at Waterville there is a basin having a depth of more than 17 feet. At the lower end of this basin, and about one-fourth of a mile below the steamboat landing, there is the shoal known as "Fort Point Rips," which has a least depth on it of 1.8 feet. In a length of 2,100 feet on this shoal the slope of the water surface was 2.5 feet. From the foot of Fort Point Rips to the head of Pettys Rips, a distance of 6,100 feet, there was a fall of 1.74 feet. Between these shoals there is a navigable channel 5 feet deep, obstructed at one point only by a shoal 100 feet long on which there is a least depth of 4.6 feet. At Pettys Rips the channel is very narrow and has a least depth of 2.5 feet. In a length of 2,800 feet over this shoal there is a fall of 2.44 feet and 1.5 feet of this fall is taken up in a distance of 900 feet at the head of the shoal. From the foot of Pettys Rips to Carters Ledges, a distance of 4,200 feet, there is a fall of 0.8 foot. Through this pool there is a channel 5 feet deep obstructed at one point by a shoal 350 feet long, on which there is a least depth of 4.1 feet. At Carters Ledges the bottom of the river is almost all solid rock, and ledge crops out above the water surface in a number of places. There is a practicable channel between these ledges which has a depth almost the entire distance of 6 feet or more, but at one point it is obstructed by ledge, on which there is only 4.4 feet. For a length of 1,000 feet over this shoal there is a fall in the water surface of 1 foot and a further fall 0.15 foot to the foot of the rapids, a distance of 800 feet.

At Fort Point Rips the shoal is caused by bowlders and coarse gravel. Nine tests of the bottom were made on this shoal by driving a steel rod from 6 to 8½ feet below the water surface without encountering ledge above a depth of 6 feet.

At Pettys Rips an irregular reef of ledge extends from the eastern bank nearly across the river, leaving a channel only 75 feet wide along the westerly shore. This channel is obstructed by bowlders and coarse gravel, and by tests made with the steel rod underlying ledge was found to extend across the head of the channel at a depth of 5 feet below the water surface.

The width of the river between Vassalboro and Waterville varies from 400 to 800 feet, the general width being 500 feet. The banks of the river throughout the entire distance from Augusta to Waterville are stable, being generally coarse gravel or ledge, with sand a small part of the distance. At only three places is any marked caving taking place, and at these points it is not great enough to be of any serious consequence.

For a number of years past the river has been used almost exclusively for the floating of loose logs from the headwaters of the Kennebec and its tributaries to the mills along the banks, or to a point 2 miles below Augusta, where they are made into rafts to be transported farther down the river. The value of these logs when sawed is estimated at over a million dollars annually. This industry is managed by a company which has almost completely appropriated the river as a flume for its logs during five or six months of the year, and has by means of piers, buoys, and chained logs constructed booms, which, in several places, have entirely closed the channel to navigation during the logging season. At the time of the survey the "drive" was at its height, and the logs interfered greatly with the work, and in three or four places were so jammed as to make a satisfactory examination impracticable.

The present steamboat navigation of the river consists in a light-draft stern-wheel boat built between two and three years ago by a company of citizens of Waterville, to ply between Augusta and that point. This boat proved to be of greater draft than was expected, drawing when loaded about 2¼ feet of water. For this reason it could only run for a month or two in the spring and before the water had dropped to summer level. Beside the shoal water it had to contend with the floating logs which at some of the worst places, especially Pettys Rips and Carters Ledges, occupy the entire channel.

The improvement desired seems to be for practicable navigation for light-draft boats and barges from Augusta, the present actual head of navigation, to Waterville. These boats and barges would be used for transporting bulky freight, mostly coal, up the river. The Maine Central Railroad follows the river closely from Augusta to Waterville, but it is claimed by citizens of Waterville that by making the river navigable the saving in freight rates to Waterville would be large enough annually to justify a moderate expenditure for the improvement. The trouble caused by floating logs would have also to be in some way abated to make navigation safe. To force the logging company to raft their logs below Waterville would be so expensive as to seriously cripple the industry. The only practicable method would appear to be to compel the logging company to construct a boom almost the entire length of the river which would leave a channel free from logs and sufficient for safe steamboat navigation. At the narrow places where it would be impracticable to divide the channel a sufficient force of men would have to be kept on duty by the logging company to check back the logs at such times as steamboats wished to pass.

The simplest improvement for the upper part of the river would be the construction of a lock and dam at Carters Ledges, or at Vassalboro, but the cost (roughly $125,000) would be out of proportion to the benefits to be derived and would still leave the part of the river below the dam to be improved. Another objection to this plan of improvement is that by raising the water high enough to give a navigable depth at Fort Point Rips the water power at Waterville would be to some extent interfered with.

The estimate herewith submitted is to obtain a channel 60 feet wide on the bottom and 5 feet deep at the stage of water to which the soundings on the map are referred. Such channel could be obtained by dredging, at all the shoals except Carters Ledges where the removal of a small amount of ledge would be necessary. This width and depth for the channel was fixed upon as they are the greatest which can be secured without removing large quantities of ledge.

At extreme low-water stages there would be at least 1 foot less depth on the shoals, leaving a navigable depth of not more than 4 feet at such stages after the improvement is completed. The material to be dredged is all coarse gravel and bowlders. The rock to be removed at Carters Ledge is solid ledge.

The prices given in the estimate are based on the expectation of the work being done by contract, and above the dam competition would be limited to such small dredges as can pass through the lock. A lump sum of $500 is added to the estimate for the removal of bowlders from the channel between the points to be dredged.

The channels proposed have been made as nearly straight as practicable while following closely the line of deepest water. The locations of the proposed cuts are marked on the tracings submitted.

ESTIMATE.

Dredging coarse gravel and bowlders below dam at Augusta, 11,548 cubic yards, in scows, at $1.25	$14,435.00
At shoal below Pettys Rips, 1,100 cubic yards, in scows, at $1.50	1,650.00
At Pettys Rips, 5,225 cubic yards, in scows, at $1.50	7,837.50

At shoal above Petty Rips, 300 cubic yards, in scows, at $1.50	450.00
At Fort Point Rips, 10,567 cubic yards, in scows, at $1.50	55,850.50
Removal of ledge at Carters Ledges, 165 cubic yards, at $5	825.00
Removing bowlders from channel	500.00
Contingencies	4,252.00
Total	45,800.00

If it should be thought advisable to add 50 feet to the length of the lock at Augusta, an improvement which is said to be desired, $25,000 would have to be added to this estimate, making a grand total of $70,800 as the cost of the whole improvement.

Very respectfully, your obedient servant,

F. S. BURROWES,
Assistant Engineer.

Lieut. Col. PETER C. HAINS,
Corps of Engineers, U. S. A.

APPENDIX B.

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN MASSACHUSETTS.

REPORT OF LIEUTENANT-COLONEL S. M. MANSFIELD, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Newburyport Harbor, Massachusetts.
2. Merrimac River, Massachusetts.
3. Powow River, Massachusetts.
4. Ipswich River, Massachusetts.
5. Harbor of refuge, Sandy Bay, Cape Ann, Massachusetts.
6. Gloucester Harbor, Massachusetts.
7. Manchester Harbor, Massachusetts.
8. Salem Harbor, Massachusetts.
9. Lynn Harbor, Massachusetts.
10. Winthrop Harbor, Massachusetts.
11. Boston Harbor, Massachusetts.
12. Weymouth River, Massachusetts.
13. Hingham Harbor, Massachusetts.
14. Scituate Harbor, Massachusetts.
15. Plymouth Harbor, Massachusetts.
16. Wellfleet Harbor, Massachusetts.
17. Provincetown Harbor, Massachusetts
18. Chatham Harbor, Massachusetts.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., July 8, 1892.

GENERAL: I have the honor to transmit herewith annual reports for the works of river and harbor improvements in my charge for the fiscal year ending June 30, 1892.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieutenant-Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

B 1.

IMPROVEMENT OF HARBOR AT NEWBURYPORT, MASSACHUSETTS.

Newburyport is situated on the south bank, 2½ miles approximately, from the mouth of the Merrimac River. The river empties into the Atlantic Ocean midway between Cape Ann and Portsmouth, or about 30 miles a little east of north from Boston in a direct line.

The outlet of the river between Plum Island and Salisbury Point is 1,000 feet wide and 30 feet deep at mean low water. At a distance of nearly a mile outside lies a sandy bar, thrown up by wave action, through which, previous to the improvement, a channel, variable in position, direction, and depth, was maintained by the current of the river, increased by the tidal prism in a large interior basin, due to a range of tides equaling 7½ feet.

For 1,000 feet outward from the gorge toward the crest of the bar the current was able to maintain a channel of navigable width and 18 feet deep at mean low water, and for a further distance of 1,500 feet a channel 12 feet deep. From the 18-foot contour line on the inside to the same on the outside the distance was 4,000 feet, and between the 12-foot contours the distance was 3,000 feet.

The depth on the crest of the bar was generally less than 7 feet at mean low water.

The object of the improvement is to create through the outer bar a channel 1,000 feet wide and at least 17 feet deep at mean low water, so that vessels may cross the bar and find a harbor at any stage of the tide, with as great draft as can reach Newburyport by the river at high tide.

The project submitted September 16, 1880, proposed two converging rubblestone jetties, their outer ends parallel for 1,000 feet, and about the same distance apart, and the protection of the beach in their vicinity. This was modified in 1882 so as to provide for the partial closing of Plum Island Basin, with a timber dike about 800 feet long and 5½ feet above mean low water.

The direction of the south jetty and the character of the shore protection was modified in 1883. The north jetty, from Salisbury Beach, is to be 4,000 feet long, approximately, and the south jetty, from Plum Island, is to be 2,400 feet long, approximately.

Both are 15 feet wide on top, which is in a plane 12 feet above mean low water. The two jetties have slopes of 1 on 2 on the sea side, and of 1 on 1 on the harbor side.

A map showing the location of the jetties is published in the Annual Report of the Chief of Engineers for 1885.

Their form and dimensions are shown in the Report for 1881. The location and details of construction of the dike are given in the Report for 1883. The estimated cost of the improvement was $375,000.

The total appropriations to date have been $257,500.

The amount expended to June 30, 1891, was $234,712.75.

On June 30, 1891, the condition of the improvement was as follows: The north jetty was completed for 2,300 feet in length, and 375 feet in addition were partly completed; the south jetty had been completed 1,077 feet, and partly completed for an additional length of 223 feet, and its shore end had been strengthened by a durable sand catch; the dike had been completed so far as was prudent at the time for its safety. It was 817 feet long, 5½ feet high above mean low water, except that near its center a weir had been left 150 feet long and 2 feet above mean low water. The least depth in the channel across the bar was 12.1 feet at mean low water. Operations were in progress under a contract with Mr. J. H. White to deposit in the north jetty 10,000 tons, more or less, of rubblestone.

This contract was completed during the year; a total of 11,445 tons of rubblestone was deposited under it, and the north jetty was completed for a length of 2,485 feet.

During the latter part of June, 1892, a survey of the bar was made. It shows that the channel crossing the bar has changed but slightly in direction since the survey of 1891, but has deepened so that the least depth at mean low water is 13.1 feet in a navigable channel at least 200 feet wide. The distance across the bar between the 18-foot contours is 2,100 feet. On the outside of the bar some advance of the deep-water contours is noticed. Inside the bar and between the jetties, no important change is noted in the deep-water contours.

At the date of this report the north jetty is completed for a length of 2,485 feet, and partly completed for 190 feet in addition. The south jetty and the dike are in the same condition as on June 30, 1891.

From notes furnished by Mr. Hiram F. Mills, engineer of the Essex

Company at Lawrence, Mass., it is seen that the spring freshet in the Merrimac River this year was less than the average spring freshet in duration and extent.

To complete the improvement, an appropriation of $117,500 will be required, all of which could be expended to advantage during the fiscal year ending June 30, 1894, in the extension of both jetties to their full projected lengths.

The advantages to be derived from the completion of the project are the deepening and widening of the channel across the bar, thereby affording a harbor of refuge on the inside of Salisbury Beach, and giving easy access at high tide to the wharves at Newburyport for vessels drawing 17 feet, approximately.

This work is located in the collection district of Newburyport, Mass., of which Newburyport is the port of entry. The nearest light-house is on Plum Island, at the entrance of the harbor.

The accompanying commercial statistics for the fiscal year ending June 30, 1892, have been furnished by the collector of customs for Newburyport, Mass.

The dates and amount of appropriations for this work are as follows:

Act of—		Act of—	
June 14, 1880	$50,000	August 11, 1888	$25,000
March 3, 1881	40,000	September 19, 1890	25,000
August 2, 1882	40,000		
July 5, 1884	40,000	Total	257,500
August 5, 1886	37,500		

Money statement.

July 1, 1891, balance unexpended	$22,787.25
June 30, 1892, amount expended during fiscal year	16,311.04
July 1, 1892, balance unexpended	6,476.21
Amount appropriated by act approved July 13, 1892	20,000.00
Amount available for fiscal year ending June 30, 1893	26,476.21
Amount (estimated) required for completion of existing project	97,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	97,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

Amount of revenue collected, 1890, $1,955.68; 1892, $364.96.

Shipping.	1890.		1891.		1892.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
Entrances:						
Foreign	25	2,425	8	892	3	387
Domestic	321	88,825				
Clearances:						
Foreign	41	6,411	8	913	4	485
Domestic	309	85,384	4	780	16	4,085

Imported.	1890.	1891.	1892.
	Tons.	*Tons.*	*Tons.*
Coal	208,000	1,470	563
Lumber	1,000		*135,000
Miscellaneous	340	190	

* Feet.

Average draft of vessels entering the harbor is 10 feet; maximum draft, 15 feet.

The coal business at this port is annually increasing, but there being no inspector statistics can not be given.

B 2.

IMPROVEMENT OF MERRIMAC RIVER, MASSACHUSETTS.

The mouth of the Merrimac River is 15 miles northwest from Cape Ann, Massachusetts. Tide water extends up it a distance of 19 miles, or to the foot of the "Upper Falls," 1½ miles above Haverhill, Mass.

Seven incorporated cities and the largest mills in New England are directly interested in its improvement.

Before improvement the channel was narrow and crooked and much obstructed by ledges, bowlders, and shoals.

At mean low water vessels drawing not to exceed 7 feet could enter the river and proceed to South Amesbury, 9 miles from the mouth. The sea bar at the mouth of the river has been improved under specific appropriations for improvement of Newburyport Harbor, while many sunken rocks and wrecks of piers and vessels lying inside the bar have been removed by general appropriations for the improvement of the river.

The object of the Merrimac River improvement is to straighten, widen and deepen the natural channel from the bar to head of tide water at the upper falls of a group known as "Mitchells Falls."

The rise or fall of the tide at the mouth is 7.7 feet; at Haverhill Bridge, 4 feet.

No plan of the river above Newburyport has been published in the reports of the Chief of Engineers.

The project originally adopted in 1870 proposed to remove obstructions from the Upper and Lower Mitchells Falls, and to remove the gangway rock and the "Boilers" in Newburyport Harbor.

The cost was estimated to be $69,025.

This project was modified in 1874 so as to include the removal of rocks in and near the draw of the bridge at Deer Island, 2 miles above Newburyport, and Rocks Bridge, and at Little Curriers Shoal, East Haverhill, so that the channel should have the following depths at ordinary high-water stages of the river:

From the mouth to Deer Island Bridge, 5 miles, 16½ feet; thence to Haverhill Bridge, 12½ miles, 12 feet; thence, to the foot of Mitchells Falls, Hazeltine Rapids, 1½ miles, 10 feet; thence, through Mitchells Falls to the head of the Upper Falls, 2½ miles, not less than 4½ feet, when the mill water at Lawrence is running.

This revised project was estimated to cost $147,000.

The total appropriations to date have been $240,866.72.

The total expenditures to June 30, 1891, were $230,866.72.

The excess of expenditures over the estimate is due to the removal of rocks and other obstructions that were unknown and removal not contemplated when the estimate was made, and by the expense of necessary surveys and examinations not provided for in the estimate.

The condition of the improvement June 30, 1891, was as follows:

The modified project of 1874 was completed with the exception of the removal of the "Boilers," upon which no work had been done.

During the year ending June 30, 1892, no active operations have been in progress. The funds made available by the act of September 19, 1890, were appropriated for the improvement of Mitchells Falls, and as the amount was deemed insufficient for any practicable benefit to commerce, my recommendation that the funds be retained in the Treasury until further funds are provided, or until by subsequent legislation it can be applied to some other part of the river where its expenditure will be of benefit to commerce, was approved by the Secretary of War August 29, 1891.

The project, as modified in 1874, has been completed with the exception of the removal of the "Boilers," but from 1883 to 1886 additional improvements were recommended as follows:

For that part of the river below Mitchells Falls—	
(1) To remove sunken rocks and shoals from Mitchells Falls	$1,500
(2) To remove the "Boilers" to a depth of 5 feet at mean low water, 350 cubic yards, at $25	8,750
Contingencies	1,250
Total	11,500

To extend the improvement so that the same depth of water as is now obtained through Mitchells Falls can be carried to Lawrence (a distance of 5 miles from the head of the falls) was in 1882 estimated to cost, for dredging through Gages Shoal and Andover Bar and removing bowlders and ledges, $11,000.

The improved channel is in good order.

This work is located in the collection district of Newburyport, Mass., of which Newburyport is the nearest port of entry. The nearest light-houses are the Plum Island Lights and the Newburyport Upper Harbor Lights.

Commercial statistics are included in statement for Newburyport Harbor.

No increase in the tonnage of the river is apparent since the improvement was commenced, and no new lines of water transportation have been established.

The dates and amounts of appropriations for this work are as follows:

Act of—		Act of—	
May 23, 1828	$32,100.00	March 3, 1875	12,000.00
April 23, 1830	3,506.72	June 18, 1878	10,000.00
March 2, 1831	16,000.00	March 3, 1879	5,000.00
March 2, 1833	4,900.00	June 14, 1880	12,000.00
June 28, 1834	3,860.00	March 3, 1881	9,000.00
July 11, 1870	25,000.00	August 2, 1882	9,000.00
March 3, 1871	25,000.00	July 5, 1884	3,500.00
June 10, 1872	25,000.00	September 19, 1890	10,000.00
March 3, 1873	25,000.00		
June 23, 1874	10,000.00	Total	240,866.72

Appropriations made since 1870 have been expended on the approved project of that date and its modifications.

Money statement.

July 1, 1891, balance unexpended	$10,000.00
June 30, 1892, amount expended during fiscal year	9.48
July 1, 1892, balance unexpended	9,990.52
Amount appropriated by act approved July 13, 1892	1,500.00
Amount available for fiscal year ending June 30, 1893	$11,490.52

B 3.

IMPROVEMENT OF POWOW RIVER, MASSACHUSETTS.

Powow River is a tributary of the Merrimac River, which it joins from the north about 3½ miles above Newburyport. The tide enters the river a distance of about 9,600 feet, following the channel or to a dam just above the town of Amesbury, Mass.

The present channel is narrow, exceedingly crooked, and is not navigable at low water. The mean range of the tide at the mouth of the river is 6.7 feet.

The general project for the improvement of the river was proposed January 24, 1885. It was based on the survey provided for in the river and harbor act of July 5, 1884.

This project proposed to make a channel 9,600 feet long, 60 feet wide on the bottom, and 12 feet deep at mean high water, at an estimated cost of $77,000.

Two appropriations have been made for this improvement, viz, by the river and harbor act of August 11, 1888, which appropriated $3,000 for dredging:

> *Provided,* That this sum shall not be expended until the towns of Amesbury and Salisbury, or either of them, shall have caused such a draw to be placed in the present bridge over said river as may be approved by the Secretary of War.

And by the river and harbor act of September 19, 1890, $5,000, with a similar proviso.

On April 10, 1889, the Secretary of War approved the plan of the proposed bridge.

On May 11, 1892, the chairman of the selectmen of the town of Amesbury, Mass, stated that the bridge over the Powow River had been reconstructed in accordance with the approved plans.

The available funds are insufficient to afford any appreciable benefit to commerce by their expenditure, and they will be retained in the Treasury until additional funds are provided.

To complete the improvement will require an appropriation of $69,000. Of this amount $30,000 could be expended to advantage during the fiscal year ending June 30, 1894.

This work is located in the collection district of Newburyport, Mass., of which Newburyport is the nearest port of entry. The nearest light-houses are the Newburyport Upper Harbor Lights.

Commercial statistics are included in statement for Newburyport Harbor. No increase in the tonnage of the river is apparent and no new lines of water transportation have been established.

Money statement.

July 1, 1891, balance unexpended	$8,000.00
July 1, 1892, balance unexpended	8,000.00
Amount appropriated by act approved July 13, 1892	4,000.00
Amount available for fiscal year ending June 30, 1893	12,000.00
Amount (estimated) required for completion of existing project	65,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

B 4.

IMPROVEMENT OF IPSWICH RIVER, MASSACHUSETTS.

Ipswich River empties into Plum Island Sound 9 miles south of Newburyport, Mass., and at the same distance west of Cape Ann. The head of navigation is 3 miles above the mouth.

The entrance of Plum Island Sound is 2 miles east of the mouth of the river. Six feet depth at mean low water can be carried over the bar at the entrance to the sound, and between the bar and the mouth of the river there is a good anchorage, with from 3 to 5 fathoms of water.

Before improvement the channel of the river from its mouth to Barras Turn, a distance of 2 miles, was at least 60 feet wide and 4 feet deep at mean low water. From Barras Turn to the town wharves, a distance of 1 mile, the channel was narrow and crooked, and had at some places but 1½ feet depth at mean low water. The mean rise or fall of the tide is 8.4 feet.

The original project for improvement was submitted December 6, 1875. It proposed a channel 60 feet wide and 4 feet deep at mean low water from Barras Turn to the town wharves, at an estimated cost of $25,000.

On November 5, 1883, the original project was divided into three partial projects:

1. The removal of the ledges at Heards Point and opposite Nabbys Point to a depth of 2 feet at mean low water, to open a navigable channel of that depth, at a cost of $15,900.
2. To dredge the shoals at Labor-in-Vain and The Shoals so as to open a channel 4 feet deep at mean low water and 60 feet wide, at a cost of $2,200.
3. To straighten the channel by making a cut across Barras Turn, and to build a jetty to close the old channel, at a cost of $6,900.

In the annual report of 1887 it was recommended that the general project be modified by limiting the present improvement to opening a channel 60 feet wide and 4 feet deep through The Shoals and Labor-in-Vain, and extending it to the Deep Hole opposite the town wharves.

A chart showing this limited project was published in the Report of the Chief of Engineers for 1887.

The amount which has been appropriated for this improvement to date is:

By act of—	
August 5, 1886	$2,500
August 11, 1888	2,500
Total	5,000

The amount expended to June 30, 1891, was $2,537 08, and a channel had been dredged 4 feet deep at mean low water, 60 feet wide at Labor-in-Vain, and 40 feet wide at The Shoals.

During the fiscal year no operations were in progress.

Proposals were twice invited during the year 1889, and it is evident that the work will cost more than the original estimate. The expenditure of the small amount available would result in no appreciable benefit to commerce; it therefore will be retained in the Treasury until additional funds are provided.

The condition of the improvement at date is the same as on June 30, 1891.

To complete the original project would require an appropriation of $20,000, but the present proposed partial project, it is believed, will fully meet all the reasonable demands of the present commerce of the river, and this it is estimated can be effected by an additional appropriation of $2,500.

Ipswich River is in the collection district of Newburyport, Mass. The nearest light-house is the Ipswich Light on Castle Neck, about 1¼ miles southeast from the mouth of the river.

Commercial statistics are included in those of Newburyport Harbor.

No increase in the tonnage of the river is apparent and no new lines of water transportation have been established.

Money statement.

July 1, 1891, balance unexpended	$2,462.92
July 1, 1892, balance unexpended	2,462.92
Amount appropriated by act approved July 13, 1892	2,500.00
Amount available for fiscal year ending June 30, 1893	4,962.92
Amount (estimated) required for completion of existing project	17,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	2,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

B 5.

HARBOR OF REFUGE, SANDY BAY, CAPE ANN, MASSACHUSETTS.

Sandy Bay is situated at the northeastern extremity of the promontory of Cape Ann, which forms the northern limit of Massachusetts Bay. The shore lines of the bay form a little less than a right angle, and their directions are nearly north and south, and east and west. The rocky island of Straitsmouth forms the eastern extremity of one shore line, and the steep headland of Andrews Point the northern end of the other.

Following the line of the proposed breakwater, the bay is 2¾ miles wide, and it has a depth of 2 miles approximately.

The bay on the land side is perfectly protected by steep high hills, but it fronts the northeast, and is open to the full force of the violent northerly and easterly gales of this coast.

The great seas of the ocean are broken, however, in a degree by the sunken rocky ledges called Averys Ledge, the Dry and Little Salvages, the Flat Ground, and Abners Ledge, which are directly at the mouth of the bay. Inside these entrance ledges the bay is entirely unobstructed, and has an average depth of 50 feet at mean low water.

A plan of the bay, showing the proposed breakwater, was published in the Annual Report of the Chief of Engineers for 1886, page 582.

The original project for improvement was submitted in 1884. It proposed a continuous breakwater 9,000 feet long, divided into two branches; one starts at Averys Ledge and runs in a direction a little west of north to Abners Ledge, a distance of 3,600 feet; the other extends 5,420 feet from Abners Ledge in a northwesterly direction, and terminates at the 84-foot contour off Andrews Point.

The axis of the proposed breakwater is approximately at the inner edge of the ledges at the entrance of the bay, and about 1 mile inside the Salvages and Flat Ground, which receive the first shock of easterly storm waves.

The southern entrance to the proposed harbor lies between Straitsmouth Island and Averys Ledge, and is to be 1,800 feet wide and at least 30 feet deep. The northern entrance, near Andrews Point, is 2,700 feet wide and 80 feet deep.

They are so located with reference to each other that vessels can enter and leave the harbor with any wind.

The harbor formed by the breakwater covers an anchorage of 1,377 acres, in which the depth exceeds 24 feet at mean low tide.

The original project proposed to build the substructure of the breakwater to the level of 22 feet below low water of a mound of rubblestone, 40 feet wide on top.

On March 2, 1892, the project was modified to include the entire breakwater by a report of the special board of engineers constituted for that purpose.

This project was approved March 17, 1892, and it proposes to construct the entire breakwater of rubblestone, with the following section: On the sea side, from the bottom to 15 feet below mean low water, a slope of 1 on 1½; thence, to mean low water, 1 on 3; thence to 18 feet above mean low water, 1 on 1; the width on the crest, 20 feet; and the rear slope 1 on $\frac{73}{100}$ to mean low water; thence, to the bottom, 1 on 1.

The axis of the eastern branch of the breakwater is indicated by an iron spindle on Averys Ledge when in range with the south light-house on Thatchers Island. Cross ranges are established by iron pipes let into the rocks on Dry and Little Salvages, which mark points at intervals of 100 feet from the spindle (initial point) on Averys Ledge.

The axis of the north branch is cross range 3,640.

The estimated cost of the improvement is $5,000,000, to which must be added $2,500,000 for buoyage, lighting, and defense of the harbor.

These estimates are based upon consecutive annual appropriations of not less than 10 per cent of the original estimates of cost.

Should operations be suspended at any time from want of funds, or annual appropriations be reduced to small sums for a series of years, the expense for the final construction will be proportionally increased.

The amount which has been appropriated to date is $450,000.

The total amount expended to June 30, 1891, was $322,321.37. At that date 407,173 tons of rubblestone had been deposited in the breakwater, essentially completing its substructure between cross ranges 140 and 3,740.

During the fiscal year 108,515 tons of rubblestone were deposited in the breakwater, under a contract dated December 4, 1890, with the Rockport and Pigeon Hill Granite companies, essentially completing the substructure of the breakwater between cross ranges 140 and 4,740.

On June 10, 1892, this contract was extended three months from July 1, 1892, at the request of the contractors.

To complete the project will cost $4,550,000, approximately.

During the year ending June 30, 1894, $250,000 could be expended to advantage.

The prospective benefits to commerce and navigation by the construction of this harbor of refuge are increased to life and property, and a consequent reduction in freight and insurance.

Sandy Bay is situated in the collection district of Gloucester, Mass.

The nearest light-house is Straitsmouth Light, situated on Straitsmouth Island, at the southern entrance to the bay.

The accompanying commercial statistics for the fiscal year ending June 30, 1892, have been furnished by Mr. Charles S. Rogers, Rockport, Mass.

The dates and amounts of appropriations for this work are as follows:

Act of July 5, 1884	$100,000
August 5, 1886	100,000
August 11, 1888	100,000
September 19, 1890	150,000
Total	$450,000

Money statement.

July 1, 1891, balance unexpended		$127,678.63
June 30, 1892, amount expended during fiscal year		77,020.52
July 1, 1892, balance unexpended		50,658.11
July 1, 1892, outstanding liabilities	$19,627.18	
July 1, 1892, amount covered by uncompleted contracts	16,351.53	
		35,978.71
July 1, 1892, balance available		14,679.40
Amount appropriated by act approved July 13, 1892		150,000.00
Amount available for fiscal year ending June 30, 1893		164,679.40
Amount (estimated) required for completion of existing project		4,400,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		250,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

COMMERCIAL STATISTICS.

Articles.		1891.	1892.
Shipped:			
Stone	tons	160,000	199,191
Received:			
Coal	do	8,126	8,153
Wood	cords	490	160
Lumber	feet	200,000	300,000
Fish	pounds	2,340,000	3,115,000
Mackerel	barrels	....	1,000
Fish sounds	pounds	....	20,000
Lobsters	barrels	600	1,000
Cod oil	gallons	7,200	8,000
Medicine oil	do	4,700	4,000
Salt	hogheads	1,000	1,200

REPORT OF BOARD OF ENGINEERS ON LOCATION, PLAN, AND ESTIMATES FOR HARBOR OF REFUGE AT SANDY BAY, CAPE ANN, MASSACHUSETTS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., March 2, 1892.

GENERAL: The Board of Engineers, constituted by Special Orders No. 91, Headquarters, Corps of Engineers, July 26, 1884, "to consider and report upon the location, plan, and estimates for a national harbor of refuge at Sandy Bay, Cape Ann, Massachusetts," ordered to reassemble at the call of the senior member "to consider and report upon plan for superstructure of the breakwater at that place," by Special Orders No. 3, Headquarters, Corps of Engineers, January 12, 1892, and to "report a plan for substructure as well as superstructure for the *entire* breakwater proposed for that locality," by Department letter dated February 1, 1892, has the honor to submit the following report:

Sandy Bay is situated at the northeastern extremity of the promontory of Cape Ann, which forms the north limit of Massachusetts Bay. Its shore lines form a little less than a right angle, and their directions are nearly north and south and east and west. The rocky island of Straitsmouth forms the eastern extremity of one shore line, and the steep headland of Andrews Point the northern end of the other.

Following the adopted line of the breakwater, the bay is 2¾ miles wide and has a depth of about 2 miles.

On the land side the bay is perfectly protected by steep, high hills, but it is open to the full force of the violent easterly and northeasterly gales of this coast.

At the mouth of the bay sunken rocky ledges exist, viz: Avery Ledge, the Dry and Little Salvages, the Flat Ground, and Abner Ledge. Inside these ledges the bay is entirely unobstructed, and has an average depth of 50 feet at mean low water over an area of about 1,300 acres.

The river and harbor act of August 2, 1882, provided for an examination or survey of this bay with a view to the construction of a harbor of refuge.

Maj. C. W. Raymond, Corps of Engineers, the local engineer, on November 28, 1883, submitted a survey, project, and estimate for a breakwater to form the proposed harbor. His report, which will be found in the Annual Report of the Chief of Engineers for 1884, page 565, states that the project is preliminary and that detailed plans can only be determined after a protracted study of the forces in operation.

This Board, which then consisted of Col. Charles E. Blunt and Lieut. Cols. Wm. P. Craighill and Walter McFarland, Corps of Engineers, in its reports of August 22 and November 20, 1884, stated that the lines selected for the breakwater by the local engineer were the best that could be adopted for the formation of "a national harbor of refuge of the first class" in this locality, if it be decided that such a harbor is necessary. The Board expressed no opinion as to the character and details of the structure proposed, it being understood that these would depend upon investigations to be made before the commencement of the work, or during the earlier progress of operations on the substructure. The reports of the Board above referred to are published in the Annual Report of the Chief of Engineers for 1885, pages 523 and 528.

No detailed plan for this breakwater has yet been adopted by the Department, but the work in progress upon its construction since November, 1885, has been carried on in conformity with the preliminary project, modified from time to time by the approval of propositions for the expenditure of successive appropriations. A brief statement of the main features of the preliminary project, and of the modifications already adopted, with the reasons leading thereto, seems necessary to show the present condition of the improvement, and to explain the recommendations made by this Board, which are based upon the later experiences here and elsewhere in this and other countries.

The breakwater, as proposed by the local engineer and approved by the Board of 1884, consisted, essentially, of two branches, one starting from Avery Ledge and extending north by west to Abner Ledge, a distance of about 3,600 feet; the other starting from Abner Ledge and extending west-northwest for a distance of about 5,400 feet. Along the southern branch, between Avery and Abner ledges, the average mean low-water depth is only about 45 feet, while along the western branch the average mean low-water depth is about 65 feet. The essential features of the structure adopted for estimate in the preliminary project of 1884 are as follows:

1. A solid conical pier of masonry on Avery Ledge, the diameter at top being 30 feet and at bottom 45 feet, and a similar but smaller pier at the western end of the breakwater.

2. A substructure consisting of an enrockment formed by dumping granite grout from barges, the smallest rubble placed in the core, the medium-sized in the inner layer and the largest in the outer covering. This arrangement was intended to increase the volume of the voids, and thus diminish the amount of stone required for the enrockment, and was based upon the experience at Bastia. The upper surface of the substructure was to be 15 feet below extreme low water. This depth was at that time considered to be the limit of the effective action of the sea, the adopted project for the Delaware Breakwater placing the base of the superstructure only 12 feet below mean low water.

3. A superstructure consisting of a masonry wall formed of very large stones laid up dry below water, and above low water a masonry wall laid in cement. The dry wall below water was provisionally adopted, pending further investigation, because of the great facilities for obtaining very large stones in the immediate vicinity, and because of the experience of the local quarrymen in laying large stones under water.

Assuming an annual appropriation of $400,000, and the employment of the best plant and the Bastia method, with rubble at 70 cents per ton, this breakwater was estimated by the Board of 1884 to cost $5,000,000.

It was proposed to commence the construction of the breakwater by building the pier on Avery Ledge, and to continue the work by extending the substructure and superstructure from that point along the southern branch toward Abner Ledge. This course was adopted because the southern branch of the breakwater is situated in the least depth of water, where beneficial results could soonest be obtained, and because it shelters the anchorage from the most violent northeast storms. The western branch covers the anchorage from the less violent northerly storms, and would be of little or no value until after the construction of the southern branch. Avery Ledge is the most exposed portion of the whole line, and it was considered desirable to determine by actual construction the feasibility of building this most exposed part before committing the Government to heavy expenditures on the rest of the work. Avery Ledge is a great danger to navigation, many vessels having been wrecked thereon. It was considered that a pier constructed upon it would, therefore, be of some immediate value to commerce, would form a base for experiments to determine the character and details of the superstructure, and, finally, would serve to hold in position a spindle necessary as a range in forming the substructure. It was believed that it would be otherwise impossible to maintain such a spindle permanently in this locality.

On May 20, 1885, under the orders of the Department, the local engineer submitted a detailed project for the construction of a stone and concrete pier on Avery Ledge, and reported that he had considered a project for a pier consisting of a heavy cylinder of cast iron filled with concrete, which he rejected for reasons stated. On June 25, 1885, the Board of Engineers for Fortifications and River and Harbor Improvements, etc., to whom this project was referred for consideration, reported in favor of the building of the pier "of concrete in situ inside of a cast-iron casing, following the method used in the foundations of the light-house at Duxbury Pier, Massachusetts." The Chief of Engineers, in his indorsement upon this project, dated July 2, 1885, remarked that "it would be less costly to cover Avery Ledge with masses of stone or concrete blocks, forming thus the termination of the breakwater after the portion contiguous to the ledge should have been built."

On September 10, 1885, under the orders of the Department, the local engineer submitted a project for the expenditure of the available funds. In conformity with the orders, the project provided for "a structure upon the summit of the ledge," and for the distribution of broken stone upon the bottom along the line of breakwater." By investigations in the locality, and by the study of more recent experience in foreign harbors, it had become apparent that the limit of wave action heretofore adopted—15 feet below extreme low water—was altogether too small, and that it would not be safe to establish the foundation of the superstructure at a higher level than 22 feet below mean low water. Under these circumstances it was considered that the plan for a dry masonry wall must be rejected, and that if any wall was to be built below low water it must be of concrete deposited either in place, as at Quebec and Wicklow, in bags, as at Aberdeen and New Haven, or in sloping blocks, as at Colombo, Réunion and elsewhere. The project repeats the opinion that the establishment upon Avery Ledge of a cast-iron cylinder, to be filled with concrete, is practically impossible; provides for the construction of a portion of the rubble base of the breakwater, the upper surface to be 40 feet in width and 22 feet below mean low water; states that it will probably be found most economical to construct the superstructure of concrete, and finally recommends the placing of two large concrete blocks upon the ledge. The advantages of the proposed structure on the ledge are stated in the project as follows:

1. It will test the durability of concrete exposed to ice and heavy seas in this locality. No wear from floating ice is anticipated, but it is possible that on the occasional quiet days of winter the water in contact with the concrete surface may freeze, and thus that surface may be gradually disintegrated.
2. It forms a convenient central core from which to construct in the future the pier of the breakwater, and it will be useful for this purpose without reference to the method of construction adopted. Thus the final project for the pier is left to be decided upon after the durability of concrete in this locality has been determined by actual experiment.
3. Its spindle forms a permanent range mark for the construction of the rubble base of the breakwater.

This project having been approved by the Department, work upon the rubble substructure was commenced under contract in November, 1885. The method of arranging the rubble suggested in the preliminary project was abandoned, the funds available not being sufficient to justify the establishment of the necessary plant for this purpose. Preparations were in progress for the formation of the concrete blocks when Maj. Raymond was relieved from charge of the work on February 4, 1886.

On May 14, 1886, the Department modified the plan of construction for the pier at Avery Ledge, authorizing a construction of "concrete in situ inside of a cast iron shell, as suggested by the Board of Engineers for Fortifications and for River and Harbor Improvements, etc., June 25, 1885." This cast-iron and concrete structure was completed in July, 1886; the iron shell was destroyed in less than a month, and finally the concrete and spindle were swept away. Since that time operations on Avery Ledge have been confined to the erection of spindles and their replacement when swept away by collision or storms. (The last spindle, 8 inches in diameter, sunk into the rock 34 inches, has been standing uninjured since January 1, 1889.)

Under various appropriations and contracts, work upon the base of the southern branch of the breakwater has been in progress since November, 1885. The Board is informed that at the close of the existing contract the substructure between Avery and Abner ledges, and beyond, a distance of about 5,000 feet, will have been essentially completed, with its upper surface 40 feet wide and 22 feet below mean low water, in accordance with the project. About 538,000 tons of unarranged rubble, at an average price of 67½ cents per ton, will have been deposited to form this structure. The Board finds no evidence that any of this rubble has been moved by the action of the sea.

The original project of a random stone substructure, carrying a masonry wall, was proposed in order to save the great expense of carrying the rubble mass above high water, which involves the deposit of an enormous amount of material below the limit of the effective action of storms. The execution of such a project is only possible with very large appropriations and the best appliances. If this method of construction is to be followed, the Board is of the opinion that the top width of the substructure should be 40 feet, and it should be 22 feet below mean low water, as now provided for. The Board is further of the opinion that the employment of concrete in place or in bags of large size in the construction of the superstructure is not advisable, and the only method of wall-building which gives reasonable promise of success is the method of sloping concrete blocks adopted at Colombo and Réunion.

The Board, however, is not prepared to recommend such a construction at the present time. As stated in the revised project for the Delaware Breakwater (*vide* Annual Report of the Chief of Engineers for 1891, page 1079), there is no precedent for the construction of an offshore breakwater on the sloping block system. All the breakwaters built on this plan have started from the shore, and this fact has determined the character of the plant employed. Thus at Colombo, Madras, Mormugoa, Manora, Kustendjie, and Réunion, the blocks were placed in position by large and costly overhanging balance cranes, which traveled on railways along the breakwaters, and could be run on shore during seasons of exposure. The peculiar advantages of such machines would be entirely lost in an offshore construction. The exposure of the site to the violent action of waves and currents, and the necessity of accurate adjustment imposed by the sloping block system, render the use of floating appliances entirely out of the question. A special plant would have to be devised, which would be experimental in character and doubtless very expensive. The leveling of the upper surface of the substructure for the foundation of the wall would have to be done by divers and would be slow, difficult, and costly. The construction of a pier on Avery Ledge, as an abutment for the end of the wall, would be troublesome and expensive, as shown by previous experience. Finally, no experiments have yet been made to determine the durability of concrete in this locality, and the Board is far from satisfied that this material would bear without rapid disintegration the exposure to which it would be subjected.

Under existing circumstances the Board is of the opinion that the best method of construction for the southern branch of the breakwater between Avery and Abner ledges is to form it by the deposit of granite rubble in the manner now adopted for the work in progress at the Delaware Breakwater. It is proposed to give the mound a width of 51 feet at mean low water and to form it up to that level by the deposit of random stone, so that the slopes shall be such as may be established by the action of the sea, the heaviest stones to be placed on the exposed face of the structure. It is proposed to give the superstructure, above low water, a height of 18 feet and a top width of 20 feet, with slopes of about 1 on 1 on the sea side and 1 on $\frac{73}{100}$ on the inside, formed by the heaviest stones laid in position, the interior space to be filled with rubble. The cross section provisionally adopted by the Board is shown on the accompanying sketch. It is based upon a study of the storm-developed slopes of the breakwaters at Rockport and in Delaware Bay. Experience during the progress of the work may require the modification of its form and dimensions.

As before remarked, it was originally proposed to begin the construction of the southern branch at Avery Ledge, the most exposed point of the line, in order to determine the feasibility of this part of the work before committing the Government to further heavy expenditures. This reason no longer exists, a large sum having been already expended in the formation of the substructure. The Board is, therefore, of the opinion that the work of raising the breakwater to its full dimensions should be commenced at the northern end of the branch, at Abner Ledge, which is the least exposed portion of the line, and should be gradually extended until it reaches Avery Ledge. The experience obtained from this work, and investigations made during its progress, will determine whether the head of the breakwater at Avery Ledge can be formed of large natural or artificial blocks, or which of the other methods proposed should be adopted.

For the western branch of the breakwater, the Board, with its present information, is unwilling at this time to recommend any method of construction other than the rubble mound proposed for the southern branch, although the average depth is so great that the structure will be of very great size below the level of sea action. The Board recommends for this branch the provisional adoption of the rubble method, with the cross section shown on the accompanying sketch. During the progress of work on the southern branch a thorough investigation should be made of recent foreign practice, especially at the harbor of Boulogne, with a view to possible economy by the construction of a masonry wall above low water.

The project submitted by the Board is based upon the fact that the country in the vicinity of the work is covered with hills of syenite, containing extensive quarries, from which stone can be obtained at a low price. The rubble employed is the refuse of the quarries, and its removal has hitherto been a source of expense to quarry companies. It has been estimated that the four breakwaters built out from the shore near Rockport contain about 1,500,000 tons of this refuse material. In the preliminary project the local engineer estimated the cost of the rubble in the breakwater with the present means of production at 70 cents per ton; but he was of the opinion that if extensive quarries were opened at Gap Head, Gully Point, and Straitsmouth Island, and the rock broken out by large blasts, the work could be greatly cheapened. The actual contract prices paid for stone have been 58.3 cents per ton in 1885, 71 cents per ton in 1886 and 1888, and 73½ cents per ton in 1891. The Board believes that if a contract for a very large amount of stone, which would justify the opening of quarries specially for its production, were authorized by Congress, the cost of this material would be greatly reduced.

This Board is further of the opinion that the breakwater can be completed with the section recommended, provided liberal appropriations are made by Congress for its continuation, within the estimate submitted by the Board of 1884, $5,000,000.

A map accompanies this report.

Respectfully submitted.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.
S. M. MANSFIELD,
Lieut. Col., Corps of Engineers.
C. W. RAYMOND,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
March 14, 1892.

Respectfully submitted to the Secretary of War.

The project submitted in 1884, under which work has heretofore been carried on at this locality, provides for the construction of a continuous breakwater about 9,000 feet long, extending from Avery Ledge northwest to the 86-foot contour off Andrews Point.

The estimated cost of this work was $5,000,000.

The within project by the Board of Engineers proposing plan for substructure as well as superstructure of the entire breakwater is recommended for approval. It is the opinion of the Board that with liberal appropriations the breakwater can be completed with the section now recommended within the estimate submitted, viz, $5,000,000.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Second indorsement.]

WAR DEPARTMENT, *March 17, 1892.*

The within project is approved as recommended by the Chief of Engineers.

S. B. ELKINS,
Secretary of War.

B 6.

IMPROVEMENT OF HARBOR AT GLOUCESTER, MASSACHUSETTS.

This is the most important harbor between Boston and Portland, and is the principal resort for all New England fishing vessels. It is situated at the southeastern extremity of Cape Ann, 20 miles northeast from Boston. It is easily entered when the dangerous storms of this coast occur, and provides a secure, ample shelter for all classes of vessels, except from south winds, and from these a moderate extent of protected anchorage is afforded in the inner harbor.

It contains in the outer roadstead, the inner harbor, and in the channels connecting them, sufficient deep water for the most liberal demands of commerce, but the inner harbor and channel are obstructed by bowlders, ledges, and shoals, dangerous and inconvenient to shipping, and the outer harbor or roadstead is open to the action of all southerly winds.

A plan of the harbor was published in the Annual Report of the Chief of Engineers for 1887, page 506.

The first project formed for improvement was submitted January 20, 1871, and was based on the survey ordered by act of July 11, 1870. (Report of the Chief of Engineers, 1871, page 869.)

This project proposed the removal of certain bowlders from the inner harbor at a cost of $10,606.20, and the construction of a breakwater from Eastern Point over Dog Bar to Round Rock Shoal, at an estimated cost of $494,148.65.

On November 10, 1884, Maj. C. W. Raymond, Corps of Engineers, by order of the special Board of Engineers that was considering the subject of the Sandy Bay Breakwater, submitted a project for two breakwaters at the entrance of Gloucester Harbor, one to cost $752,000 on essentially the same site as that proposed in 1871, and a supplementary one through Normans Woe Rock, to cost $607,000.

This project and estimate are published in the Chief of Engineers' Report for 1885, page 534.

On January 20, 1885, it was recommended, in accordance with act of July 5, 1884, that a survey of the inner harbor and of the reef of Muscle Point be made, and that Babsons Ledge be removed to 21 feet at mean low water. (Report of Chief of Engineers, 1885, page 541.) In the annual report for this harbor for 1887 a general project for its improvement was submitted, based on the survey provided for by act of Congress approved August 5, 1886. (Chief of Engineers' Report, 1887, page 500.)

This project proposed to remove from the inner harbor 101½ cubic yards of rock known to exist, and to dredge 216,000 cubic yards, scow measurement, at an estimated cost of $65,000; and to construct the breakwater, recommended in the project of 1884, that extends from Eastern Point to Round Rock Shoal, at an estimated cost of $752,000.

The total appropriations for this harbor to date have been $40,000.

The amount expended to June 30, 1891, was $24,648.60.

The condition of the improvement June 30, 1891, was as follows:

Clam Rock had been reduced from 1 foot to 9½ feet at mean low water; Pinnacle Rock, from 8½ to 16½ feet, mean low water; rock off Pews Wharf, from 2 to 5 feet, mean low water; rocks off J. Friend's Wharf, from 13 to 17 feet, mean low water. All of the above rocks were reduced to the level of the surrounding bottom.

Babsons Ledge had been reduced from 11 to 14 feet, mean low water; no work had been done on the breakwater.

Two channels had been dredged in Harbor Cove, approximately parallel to the heads of the wharves; the east channel was 550 feet long; the west, 1,000 feet long; both were 40 feet wide and 10 feet deep at mean low water, except over a small ledge uncovered by the dredging off Parmenters Wharf.

All the ledges obstructing the channel in the main harbor between Harbor Cove and Pews Wharf had been removed to the depth of the projected dredging in this part of the harbor, and a contract was in force with the Bay State Dredging Company to remove 40,000 cubic yards from Harbor Cove and the main harbor.

Operations under this contract were commenced in July, 1891, and satisfactorily completed in November, 1891; 47,298 cubic yards were removed.

At the date of this report the two channels in Harbor Cove are each 140 feet wide, 10 feet deep at mean low water, and the inner harbor has been improved from its entrance near Fort Point to the steamboat wharf, so that 15 feet depth at mean low water can be carried, except over four small ledges uncovered by the dredging near the Halibut Company's Wharf.

To complete the improvement will require an appropriation of $40,000 for dredging and $732,000 for the breakwater at Eastern Point. Of this amount $305,000 could be expended to advantage during the fiscal year ending June 30, 1894, in completing the proposed dredging and in commencing the breakwater.

The prospective advantages to commerce by the completion of the improvement are greater facilities and safety in the movement of vessels in the harbor, and a more safe anchorage for vessels seeking protection from southerly gales.

Gloucester Harbor is in the collection district of Gloucester, Mass., of which Gloucester is the port of entry.

The nearest light-houses are Ten Pound Island Light, in the harbor, and Eastern Point Light at its entrance.

The accompanying commercial statistics for the fiscal year ending June 30, 1892, have been furnished by the collector of customs at Gloucester, Mass.

The date and amount of appropriations for this work are as follows:

Act of—	
June 10, 1872	$10,000
August 5, 1886	5,000
August 11, 1888	10,000
September 19, 1890	15,000
Total	40,000

Money statement.

July 1, 1891, balance unexpended	$15,351.40
June 30, 1892, amount expended during fiscal year	12,043.77
July 1, 1892, balance unexpended	3,307.63
Amount appropriated by act approved July 13, 1892	40,000.00
Amount available for fiscal year ending June 30, 1893	43,307.63
Amount (estimated) required for completion of existing project	752,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	305,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

Amount of revenue collected, 1890, $50,461.23; 1891, $19,800; 1892, ——.

Shipping.	1890.		1891.		1892.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
Entrances:						
Foreign	136	29,138	146	26,235	213	43,460
Domestic	22	2,149	30	6,000	25	2,700
Clearances:						
Foreign	123	16,130	138	23,500	189	25,700
Domestic	41	13,034	57	11,220	77	17,110

Commercial statistics—Continued.

Imported.	1890.	1891.	1892.
	Tons.	*Tons.*	*Tons.*
Coal		45,000	37,200
Salt	28,324	30,000	33,000
Lumber			200
Merchandise			8,000
Miscellaneous		8,100	500

All classes of vessels frequent the harbor, from 5 tons to 1,500 tons; greatest draft, 24 feet.

The business of shipping salt to Nova Scotia, New Brunswick and Newfoundland has been established during the fiscal year.

Total number of vessels boarded during the year was 3,900.

Tonnage of district, 493 vessels, 35,200 tons.

B 7.

IMPROVEMENT OF HARBOR AT MANCHESTER, MASSACHUSETTS.

Manchester Harbor is situated about 5½ miles northeastward from the entrance of Salem Harbor, Massachusetts.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for 1888, Part 1, page 466.

The outer sheltered roadstead contains, approximately, 300 acres, with 5 fathoms of water.

The entrance channel from the roadstead to Proctors Point is everywhere at least 100 feet wide, at least 6½ feet deep at mean low water, and is unobstructed.

At the "narrows," distant 1,400 feet inside of Proctors Point, the depth in the channel is reduced to 1½ feet at mean low water; thence to the town wharves, a further distance of 2,500 feet, no low-water channel exists. Near the town wharves the channel is crossed by the Boston and Maine Railroad (eastern division), on a bridge which is provided with a draw opening 28 feet wide.

The original project for the improvement of this harbor was submitted November 28, 1887. It was based on a survey provided for in the river and harbor act of August 5, 1886. It proposed to dredge a channel 60 feet wide, 4,000 feet long, and 4 feet deep at mean low water from Proctors Point to the town wharves, at an estimated cost of $14,300.

The total appropriations for this improvement to date have been:

By the act of—	
August 11, 1888	$2,500
September 19, 1890	5,000
Total	7,500

The expenditures to June 30, 1891, were $321.67.

At that date operations were in progress under a contract with Messrs. Hamilton and Sawyer to dredge 22,000 cubic yards.

Work under this contract was commenced in June and satisfactorily completed in July, 1891; 22,052 cubic yards were removed; and, at the date of this report, the improved channel is 35 feet wide, 4 feet deep at mean low water from Proctors Point to the railroad bridge, a distance of 2,900 feet.

To complete the improvement will require an appropriation of $6,800, all of which could be expended during the fiscal year ending June 30, 1894.

Manchester Harbor is in the collection district of Gloucester, Mass., of which Gloucester is the port of entry. The nearest light-house is situated upon Bakers Island, 2¼ miles from Proctors Point.

The existing commerce is nominal and the commercial statistics are included in Gloucester Harbor.

No increase in the tonnage of the harbor is apparent, and no new lines of water transportation have been established.

Money statement.

July 1, 1891, balance unexpended	$7,178.53
June 30, 1892, amount expended during fiscal year	6,800.62
July 1, 1892, balance unexpended	377.91
Amount appropriated by act approved July 13, 1892	6,800.00
Amount available for fiscal year ending June 30, 1893	7,177.91

B 8.

IMPROVEMENT OF HARBOR AT SALEM, MASSACHUSETTS.

Salem Harbor, Massachusetts, is 12 miles to the northward of Boston, Mass. Fort Pickering Light marks its entrance, between Winter Island on the west and Naugus Head on the east. The harbor is 1,750 feet wide at its entrance and 5,500 feet long between the 12-foot contours of opposite shores. It contains a well-sheltered, entirely unobstructed anchorage of about 110 acres, of a greater depth than 18 feet, mean low water. In front of the city are extensive flats, which make long wharves necessary to reach deep water. The principal wharves of the city are located on "South River," a small stream which formerly drained a tidal basin on the southwestern side of the city. This basin is now practically filled up by city improvements. The river is 3,000 feet long to the head of navigation at South or Lafayette Street Bridge. It is crossed by a highway bridge about one-fourth of a mile below the head of navigation, with a draw opening 31½ feet wide. The width of the river varies from 300 feet at its mouth to 150 feet at the head of navigation. The greatest depth of continuous low-water channel is 0.8 feet.

The original project for the improvement of the harbor was submitted December 16, 1872. It was proposed to dredge a channel 1,730 feet long, 300 feet wide, 8 feet deep at mean low water, at an estimated cost of $32,000. This project was essentially completed, 1873–'75.

The present project for the improvement of the harbor was submitted December 2, 1889. It was based on a survey provided for in the river and harbor act of August 11, 1888. It proposed as follows:

To clean out the channel of approach to South River to the original dimensions as dredged in 1873–'75, viz: 300 feet wide at the entrance, and 150 feet wide off Derby Wharf Light, 8 feet deep at mean low water; to extend this channel with same depth, gradually reducing its width to 100 feet, to near the inner end of Derby Wharf, and from this point to the head of navigation excavate a channel 50 feet wide and 6 feet deep at mean low water.

The total length of the channel to be improved will be, approximately, 5,100 feet, and its excavation will require the removal of 85,000 cubic yards of material, at an estimated cost of $28,000.

To date the total appropriations for this harbor have been $39,000.

The expenditures to June 30, 1891, were $25,073.65. At that date the project of 1872 had been completed and a contract was in force with Mr. Augustus B. Wright to dredge 50,000 cubic yards in accordance with the project of 1889.

Operations under this contract were commenced in July and satisfactorily completed in November, 1891. Fifty thousand two hundred and thirteen cubic yards were removed.

A small ledge near Derby Wharf Light was uncovered by the dredging, and was removed under an agreement with Mr. Hiram W. Phillips at a cost of $315.

At the date of this report the improved channel is 50 feet wide, 8 feet deep at mean low water, to near the inner end of Derby Wharf, and thence to the head of navigation 6 feet deep at mean low water.

To complete the present project would require an appropriation of $14,000, all of which could be expended during the fiscal year ending June 30, 1894.

Salem Harbor, including South River, Massachusetts, is in the collection district of Salem, Mass., of which Salem is the port of entry. The nearest light-house is Derby Wharf Light, Salem Harbor, Massachusetts.

The accompanying commercial statistics for the fiscal year ending June 30, 1892, have been furnished by the collector of customs at Salem, Mass.

The dates and amounts of appropriations for this work are as follows:

Act of—	
March 3, 1873	$15,000
June 23, 1874	10,000
September 19, 1890	14,000
Total	39,000

Money statement.

July 1, 1891, balance unexpended	$13,926.35
June 30, 1892, amount expended during fiscal year	12,708.97
July 1, 1892, balance unexpended	1,217.38
Amount appropriated by act approved July 13, 1892	14,000.00
Amount available for fiscal year ending June 30, 1893	15,217.38

COMMERCIAL STATISTICS.

Amount of revenue collected, 1868, $29,687.14; 1891, $6,416.80; 1892, $3,611.62.

Shipping.	1868.		1891.		1892.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
Entrances:						
Foreign	100	225,000	117	15,168	77	10,720
Domestic	598		1,659	456,824	10	2,356
Clearances:						
Foreign			93	13,253	75	11,123
Domestic					89	5,933

Imported.

1891.		
Coal	tons	5,890
Lumber	feet	3,424
Miscellaneous	tons	2,731
1892.		
Coal	tons	3,256
Lumber	feet	875,791
Shingles		3,323,000
Laths		575,000
Eggs	dozen	1,074
Firewood	cords	854
Bark	do	310
Lime	barrels	1,000
Railroad ties		4,624

Vessels from 8 to 20 feet draft frequent the port.

B 9.

IMPROVEMENT OF HARBOR AT LYNN, MASSACHUSETTS.

Lynn Harbor is situated 9 miles northeast from Boston. It is 1 by 2 miles, approximately, in extent, the greater part of which is dry at low water.

It is protected on the north and west by the mainland, and on the east by Nahant Beach, and its entrance, 2 miles wide, into Massachusetts Bay, is on the south side.

A plan of the harbor, showing the projected improvement was published in the Annual Report of the Chief of Engineers for 1884, Part 1, page 532.

Before improvement, three narrow and crooked channels of approach to the wharves existed, in each of which there was about 6 feet depth at mean low water. The mean rise or fall of the tide is 9.3 feet.

The western channel leads to the Point of Pines and the mouth of Saugus River.

The main ship channel is entered between White and Lobster Rocks, and connects about 3,600 feet northward with the Black Rock Channel, which is the most eastern, near Nahant Beach.

The project for improvement was adopted in 1884. It provides for the excavation of a channel 200 feet wide and 10 feet deep at mean low water, from a point near and east of the White Rocks, to deep water opposite Little Nahant, a distance of 3,610 feet. This is called the outer improved channel, and is merely a rectification and deepening of the main ship channel. The combined main ship channel and Black Rock Channel are sufficient for the purpose of commerce for the next 2,500 feet. Then commences the inner improved channel, which is projected 6,450 feet long, 200 feet wide, and 10 feet deep at mean low water. It extends from deep water, opposite Sand Point, to the harbor commissioners' line, and follows very closely in direction the extension of the united main ship and Black Rock Channels.

On September 24, 1888, this project was modified. It was then proposed to extend the main ship channel 400 feet within the harbor line and to excavate at its inner end a basin 500 by 300 feet in area, 10 feet deep at mean low water.

It is supposed that the inner channel will need to be dredged occasionally to maintain its width and depth, but a training wall about 6,000 feet long, has been proposed to aid in keeping the outer channel open, if experience shall show it to be necessary. This wall is to start from the shore at "Little Nahant," and is to cross the Black Rock Channel. Its outer position is to be parallel to the outer improved channel.

The cost of the original project was estimated to be $145,000. This estimate was revised in 1885, and then made $157,000, to provide for an increased amount of dredging found to be necessary during the progress of the work, to round off the junctions of the natural channel with the dredged channel, to provide flatter slopes to the sides of the cuts than was originally designed, and also to provide funds for necessary surveys during the progress of the work.

The modifications proposed September 24, 1888, were estimated to cost $25,000, which would make the total cost of the improvement $182,000.

The total appropriations for this harbor to date have been $91,000.

The amount expended to June 30, 1891, was $75,612.46.

On June 30, 1891, the outer channel had been completed as proposed—3,610 feet long, 200 feet wide, 10 feet deep at mean low water; the inner channel was 6,450 feet long, 10 feet deep at mean low water, 150 feet wide, or 50 feet less than is proposed. The basin was 125 feet wide, 500 feet long, 10 feet deep at mean low water, connected with the main ship channel at the harbor line by a cut 100 feet wide, 400 feet long, 10 feet deep at mean low water, and a contract was in force with the New England Dredging Company to excavate 40,000 cubic yards at 18 cents per yard from the basin.

Operations under this contract were commenced in September, 1891, and satisfactorily finished in October, 1891. The basin was completed as proposed 500 feet long, 300 feet wide, 10 feet deep, at mean low water; connected with the inner channel by a cut 200 feet wide, 10 feet deep at mean low water.

During the year a survey of the outer improved channel was made, and by comparison with previous surveys it was shown that no change had occurred in the channel or its approaches since it had been dredged, and therefore the proposed training wall is not as yet necessary.

At the date of this report the improvement is in good order.

To complete the improvement will require an appropriation of $91,000, and of this amount $50,000 could be expended to advantage during the fiscal year ending June 30, 1894.

Lynn is a port of entry in the collection district of Marblehead, Mass. The nearest light-house is Egg Rock (Nahant) Light, 3 miles distant.

The accompanying commercial statistics for the fiscal year ending June 30, 1892, have been furnished by the collector of customs at Marblehead, Mass.

The date and amount of appropriations for this work are as follows:

Act of—	
August 2, 1882	$60,000
August 5, 1886	6,000
August 11, 1888	10,000
September 19, 1890	15,000
Total	91,000

Money statement.

July 1, 1891, balance unexpended	$15,337.64
June 30, 1892, amount expended during fiscal year	9,485.77
July 1, 1892, balance unexpended	5,901.87
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	15,901.87
Amount (estimated) required for the completion of existing project	81,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Amount of revenue collected 1890, $3,509.60; 1891, $4,855.96; 1892, $3,545.17.

Shipping.	1890.		1891.		1892.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
Entrances:						
Foreign	28	2,692	18	1,878	33	2,760
Domestic	489	97,800	453	95,130	734	150,000
Clearances:						
Foreign	38	4,735	21	2,702	31	3,790
Domestic	477	95,400	447	93,870	736	146,000

Imported.	1890.	1891.	1892.
	Tons.	*Tons.*	*Tons.*
Coal	146,000	147,000	148,577
Iron	1,400	750	1,447
Lumber	16,496	12,380	*10,326,000
Miscellaneous	16,246	22,786	25,000

*Feet.

All classes of vessels frequent the harbor. Number of vessels boarded during the year, 743; average draft, 13 feet; average tonnage, 230.

B 10.

IMPROVEMENT OF HARBOR AT WINTHROP, MASSACHUSETTS.

This harbor is situated in the northeastern part of Boston Harbor, immediately westward of Winthrop Head.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for the year 1888, part 1, page 470.

The harbor contains, approximately, 350 acres, all of which is dry at low tide except a short, narrow, crooked slough east of Snake Island. To the town wharf no low-water channel exists. The mean range of tides is 9.4 feet.

The nearest deep-water channel of Boston Harbor is known as the "Back" Channel, and it extends from Point Shirley to East Boston. It has from 9 to 16 feet depth at low tide. The town wharf is distant 3,900 feet from this "Back" Channel.

The original project for the improvement of this harbor was submitted November 28, 1887; it was based on the survey provided for in the river and harbor act of August 5, 1886.

The project proposes to excavate a straight channel 3,900 feet long, 50 feet wide, and 6 feet deep at mean low water from the "Back" Channel to Rices Wharf, at an estimated cost of $17,600.

For this improvement the following amounts have been appropriated:

By act of—	
August 11, 1888	$1,000
September 19, 1890	5,000
Total	6,000

The amount expended to June 30, 1891, was $5,326, and at that date the improved channel was 3 feet deep at mean low water, 3,900 feet long, and 35 feet wide. Opposite Rices Wharf it was 50 feet wide.

No operations were in progress during the fiscal year, and at the date of this report the condition of the improvement is the same as on June 30, 1891.

The beaches and headlands protecting this harbor on the east were seriously abraded by the storms of the winter 1888–'89; this abrasion has been continued and they will soon require protection, not only to secure this minor harbor, but to prevent injury to the main harbor of Boston. To complete the improvement will require an appropriation of $11,600, all of which could be expended during the fiscal year ending June 30, 1894.

Winthrop Harbor, Massachusetts, is in the collection district of Boston, Mass., of which Boston is the port of entry. The nearest light-house is situated upon Deer Island Point, Boston Harbor, Massachusetts.

The existing commerce is nominal, and commercial statistics are included in Boston Harbor, Massachusetts.

No increase in the tonnage of the harbor is apparent, and no new lines of water transportation have been established.

Money statement.

July 1, 1891, balance unexpended	$3,618.82
June 30, 1892, amount expended during fiscal year	3,116.62
July 1, 1892, balance unexpended	502.20
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	3,502,20
Amount (estimated) required for completion of existing project	8,600.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	8,600.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

B II.

IMPROVEMENT OF HARBOR AT BOSTON, MASSACHUSETTS.

Boston Harbor consists essentially of an inner and outer harbor, united by a deep waterway, and each accessible from the sea by a distinct channel, widening into a deep and spacious roadstead.

1. *Inner harbor.*—This harbor lies to the north and westward of Long Island, and has deep water and good anchorage in the President Roads, seaward of Lower Middle Bar, and also near the city, westward of Upper Middle Bar.

Four rivers discharge their waters into this basin, the Charles, Mystic, and Chelsea rivers from the north, and the Neponset from the south. The direct entrance from the sea is by Broad Sound.

2. *Outer harbor.*—This harbor lies to the southward of Long Island, and has a fine anchorage in Nantasket Roads, as well as in Hingham Bay, a well-sheltered harbor southeast of Peddock Island. It connects with the inner harbor by the main ship channel through the "Narrows," and by secondary channels east and west of Long Island. It is reached from the sea by Nantasket Roads, which lie south of Georges and Great Brewster islands, and is marked at the sea entrance by Boston Light.

Weymouth and Weir rivers empty into the outer harbor.

Both the inner and outer harbors are subdivided into several minor harbors, and contain many islands, which shelter the anchorages from winds and storm waves.

The range of tides at the navy-yard is 9.8 feet, and at the entrance to the outer harbor 9.4 feet.

A sketch of the harbor was printed in the Annual Report of the Chief of Engineers for the year 1888, page 454.

The object of the improvement is, first, to *preserve* the harbor by protecting the islands and headlands; and, second, to *improve* it, by widening, deepening, and straightening the channels.

The projects adopted for this purpose since 1866 have been mainly in accordance with the recommendations of the United States commissioners, whose labors terminated during that year.

The works of preservation consist of sea walls, aprons, jetties, etc., which protect the shores of the islands and headlands, prevent additional wash into the channels, control the tidal scour, and preserve the full height of anchorage shelter for vessels in the roadsteads.

The works of improvement have been by dredging and blasting.

The total appropriations from 1825 to date have been $2,304,276.10.

The total expenditures to June 30, 1891, were $2,147,449.18.

WORKS OF PRESERVATION.

Point Allerton.—This headland at the southeasterly entrance of the harbor is protected by a granite sea wall 1,202 feet in length, completed in 1873. Its concrete foundation for a distance of 1,005 feet is protected by an apron and eight short jetties of granite rubblestone. No work was done on it during the fiscal year.

Its condition June 30, 1892, is as follows:

The wall is generally in good order, although some of its joints should be repointed. The bluff protected by this wall is not fully covered from storm action, and the sea wall should be extended westward for a distance of at least 150 feet, and the foundation of the extension should be protected with riprap.

This is estimated to cost $15,000.

Great Brewster Island.—This island is on the north side of the main ship channel near the entrance. It is protected by a granite sea wall 2,840 feet long, which was completed in 1869. During the fiscal year the joints of about 600 running feet of the wall were repointed, and the return wall at the north end was relaid.

On June 30, 1892, the wall is in fair order, but repointing is still needed, for which funds are available, and the work will be done during the next fiscal year.

Georges Island.—Its northern and eastern shores are protected by a granite sea wall 2,150 feet long. West of this wall a riprap improvement extends for 450 feet, and south of it another 600 feet long. The sea wall and southern riprap were built about 1835.

The western riprap was built in 1884–'85. No work was done on the wall or ripraps during the year, and they are in good order at the date of this report. The unprotected western shore line of the island in front of the Government buildings was considerably abraded; the high-water line had been moved back in places nearly 25 feet. This shore line should be protected by a light sea wall 1,400 feet long, at a cost of $35,000.

Lovells Island.—The western shore of this island is protected by a rubblestone apron, 975 feet long, built in 1873, and repaired and extended in 1884; the northern shore is covered by a granite sea wall, 750 feet long, built in 1843; and the eastern shore is protected by a granite sea wall, 800 feet long, built in 1869, and repaired in 1879 and 1886, and by two rubblestone aprons, one between the northern and eastern sea walls, 1,440 feet long, and the other south of the east sea wall, 1,330 feet long.

No operations were in progress during the fiscal year.

The condition of the work on June 30, 1892, was as follows: The sea walls and the ripraps on the eastern shore were in good order; the western shore riprap had been undermined in places and had fallen down, but it needed no immediate repairs.

Gallops Island.—The western, northern, and eastern shores of this island are protected by a granite sea wall 2,085 feet long, completed in 1889, and by a rubblestone apron, completed in 1884, 3,050 feet long, which also covers the foundation of the sea wall.

During the fiscal year the extension of the sea wall 300 feet to the southeast was completed.

On June 30, 1892, the wall and ripraps are in good order.

Deer Island.—Three prominent bluffs of this island are protected by granite sea walls, originally built about 1827. The north head wall is 1,740 feet long, the middle head wall is 840 feet, and the south head wall is 380 feet long. In 1865 and 1869 these walls were partly rebuilt and in the weakest places were backed with concrete. They were all originally built dry, and from time to time have required repairs.

No operations on these sea walls were in progress during the fiscal year, and at the date of this report they are in fair order.

Long Island.—The north head of this island is protected by a granite sea wall 2,081¾ feet long, completed in 1874. Part of the foundation of the sea wall and of the beach at both its ends are protected by a rubblestone apron, aggregating 1,375 feet in length. This apron was built in 1874 and extended in 1884.

During the fiscal year 1,100 tons of rubblestone were landed on the beach at the southwest end of the sea wall, and considerable of it has been hauled in to form a riprap protection for the beach west of the sea wall. This work will be continued during the next fiscal year. At the date of this report the sea wall is in good order.

Rainsford Island.—The north head of this island is protected by a dry granite sea wall 1,500 feet long, originally built about 1840, and extensively repaired in 1884-'85. No work was done during the fiscal year, and on June 30, 1892, the wall was in good order and needed no repairs.

Castle Island.—The north and part of the east and west shores of this island are protected by a dry granite sea wall, 3,300 feet long, built in 1835. A light riprap extends along the east shore 300 feet from the end of the wall; this was built in 1865. No work was done during the year ending June 30, 1892, and at that date the riprap was in good order. The sea wall needed repairs on the north face a short distance west of the wharf, where the foundation has been undermined and the wall has settled. About 100 running feet of the wall has been thus injured, and this length of the wall needs taking down and rebuilding, at a cost of $1,000.

Governors Island.—The shore line of this island has never been protected. The east and south bluffs, however, should be covered by sea walls to prevent additional abrasion, not only to secure the sites of the important heavy batteries which occupy these bluffs, but also to prevent injury to the main ship channel.

The east bluff wall should be 500 feet long, and is estimated to cost $30,000; the south bluff wall should be 1,800 feet long, and will cost $50,000.

WORKS OF IMPROVEMENT.

The main ship channel.—Before improvement it had a least width of 100 feet and a least depth of 18 feet at mean low water. The general project for its improvement was submitted in 1867. It proposed to dredge the channel 23 feet deep at mean low water, 1,000 feet wide at the upper and lower middles and 685 feet at the Narrows.

In 1870 the proposed width at the narrows was reduced to 625 feet, and at the anchorage shoal, in the inner harbor, increased to 1,100 feet.

In 1887 it was proposed to straighten the passage through the "Narrows," by cutting off a spur that projected from Lovells Island, which was estimated to contain 20,000 cubic yards.

On June 30, 1891, the condition of the main ship channel was as follows: It was 23 feet deep at mean low water, 1,100 feet wide west of the Upper Middle, 750 feet wide at the Upper Middle, 1,000 feet wide at the Lower Middle, and at least 625 feet wide elsewhere, except off Brewster Spit, where it was 550 feet wide approximately.

In effecting this improvement, dredging or blasting was done at the following places:

At Nashs Rock Shoal, during the years 1876–'78, 365 cubic yards of ledge were removed.

At Kellys Rock and Shoal, during the years 1869–'79, 222 cubic yards of ledge were removed.

Tower, Corwin, and Channel Rocks were removed during the years 1867–'75; they aggregated 608¾ cubic yards.

From the west end of Brewster Spit, during the years 1874–'76 and 1891, 45,666 cubic yards of sand and gravel were dredged, and 95½ cubic yards of ledge were removed.

At Lovells Island, from the southeast and southwest points, 267,294½ cubic yards were dredged during the years 1867–'77, and from a spur between these points 3,430 cubic yards were dredged in 1888.

At Castle Island Bar and Shoal, opposite the Lower Middle, during the years 1880–'83, 36,957 cubic yards were dredged and 20 tons of rock were removed.

At the Lower Middle, in 1874–'75, State and Palmyra rocks were removed; they aggregated 62 cubic yards. In 1887–'89, 71,892 cubic yards were dredged from this shoal, and 375 cubic yards of ledge removed.

At the Upper Middle, during the years 1870–76, 268,278½ cubic yards were dredged and 118 cubic yards of ledge were removed; in 1880–'90, 146,182 cubic yards were dredged and 111 cubic yards of ledge were removed.

At Anchorage Shoal, during the years 1879–'82, 65,327 cubic yards were dredged.

At Man-of-War Shoal 85,917 cubic yards were dredged in the years 1878–'80.

At Mystic River Shoal, during the years 1879–'82, 82,082 cubic yards were dredged.

During the fiscal year 12,070 cubic yards were dredged from the west end of Brewster Spit, under a contract with Mr. A. R. Wright; 28,510 cubic yards were dredged under this contract, and the main ship channel at this point was made 625 feet wide.

One hundred and thirty thousand nine hundred and sixty-two cubic yards were dredged under a contract with Mr. A. R. Wright, from the extension of the main ship channel towards Jeffreys Point. This channel is now 275 feet wide, 18 feet deep at mean low water from Grand June-tion Wharf to just east of Simpson's Patent Dry Docks, and thence gradually narrows to 250 feet and shoals to 15 feet, to a junction with the same depth off Jeffreys Point.

On November 10, 1891, an advertisement was issued calling for proposals for dredging to widen the main ship channel at the upper middle bar. The bids received were opened December 10, 1891, and an abstract of them will be found in the annexed table.

On December 19, 1891, a contract was entered into with Mr. A. R. Wright to dredge 211,764 cubic yards from the upper middle bar.

Operations under this contract were commenced in April, 1892, and during the fiscal year 74,779 cubic yards were dredged and this part of the main ship channel is, at the date of this report, 800 feet wide.

On June 30, 1892, the main ship channel is 23 feet deep at mean low water, 1,100 feet wide west of the upper middle, 800 feet wide at the upper middle, 1,000 feet wide at the lower middle, and at least 625 feet wide elsewhere.

The following tributary channels have been improved by dredging or blasting.

1. CHARLES RIVER.

This river empties into the inner harbor near the navy-yard at Charlestown.

Before improvement the natural channel had, as far up as Western Avenue Bridge, 4¾ miles from its mouth, 7 feet depth at mean low water, except in several places, covering about 1¼ miles in extent below Brookline Street Bridge, where the depth varied from 4½ to 7 feet.

From Western Avenue Bridge to Arsenal Street Bridge (2½ miles) there was a depth of 4 feet at mean low water; thence to Market Street Bridge (¾ mile) 2¼ feet at mean low water; and thence to the dam at the head of tide water (1¾ miles) a depth varying from 0 to 9½ feet above mean low water. The mean rise or fall of the tides is 10 feet. A sketch showing the river was published in the Annual Report of the Chief of Engineers for 1884, page 512.

The project for the improvement of this river consists in straightening, widening, and deepening the natural channel, so that it should be from its mouth to Western Avenue Bridge 7 feet deep at mean low water and 200 feet wide; from Western Avenue Bridge to Market Street Bridge, 6 feet deep at mean low water and 80 feet wide; thence to the dam at the head of tidewater, 60 feet wide and 2 feet deep at mean low water.

The estimated cost of this improvement was originally $85,000. A revised estimate was submitted in 1881 of $125,000.

The total appropriations for this improvement to date have been $77,500.

The expenditures to June 30, 1891, were $57,500. No operations were in progress during the fiscal year, and the condition of the improvement June 30, 1892, is as follows: The projected channel has been completed from the mouth of the river to Arsenal Street Bridge (7¼ miles); work was stopped at this point for the reason that the piers and draws of this bridge do not conform to the projected channel above it. In effecting this improvement 127,971 cubic yards were dredged during the years 1880-1884.

2. FORT POINT CHANNEL.

This channel is situated between the eastern shore of Boston proper on the one side and the reclaimed and improved flats of South Boston on the other side. It connects the tidal basin of South Bay, which has an area of 250 acres, with Boston Inner Harbor, is fast becoming the center of the city's most extensive shipping trade, and is the most important branch of the main ship channel. Fort Point Channel is 1¼ miles long.

Before improvement the least depth at mean low water was 12 feet at its entrance and 17 feet above Congress Street Bridge.

That part of it which it is proposed to improve is spanned by bridges at Congress street, Mount Washington avenue, and at an intermediate point. These bridges have conveniently located draw openings, but the draw piers of the railroad bridge must be strengthened or reconstructed before the improvement can be extended past them, and the width of the draw increased to that of the other bridges above and below it.

The project for this improvement was submitted January 27, 1885 (Annual Report, Chief of Engineers, 1885, page 545).

It proposed the excavation of a channel 175 feet wide and 23 feet deep at mean low water from the entrance to near Federal Street Bridge, a distance of 4,100 feet, and was estimated to cost $100,000, the railroad bridge to be reconstructed at the expense of the owners.

By the river and harbor act of August 5, 1886, the sum of $18,750 was appropriated for the improvement of that part of the channel lying below Congress Street Bridge.

The total expenditures to June 30, 1891, were $18,750.

No operations were in progress during the year, and the condition of the improvement June 30, 1892, is as follows: The channel had been dredged as proposed from its entrance to Congress Street Bridge, a distance of 1,900 feet; 94,211 cubic yards were removed in effecting this improvement during the year 1887.

To complete the improvement as proposed to Federal Street Bridge will cost $60,000, and this sum could be expended to advantage during the fiscal year ending June 30, 1894, if the railroad draw shall have been properly reconstructed.

3. HINGHAM HARBOR.

(See separate report.)

4. NANTASKET BEACH CHANNEL.

This is a small channel along the east side of Hingham or Hull Basin. It leads to a wharf on the west side of the heel of Nantasket Beach, about 12 miles from Boston.

Before improvement it was approximately 100 feet wide, and had a depth of at least 11 feet, except at the eastern end 1,500 feet from the wharf, where the width was reduced to from 40 to 50 feet and the depth to less than 8 feet. It was circuitous and obstructed by bowlders at the mouth of Weir River, and by a ledge near the wharf.

The project adopted in 1880 was to widen and deepen the channel from the mouth of Weir River to the steamboat wharf so that it would be 100 feet wide and 9½ feet deep at mean low water, to remove a few bowlders at the mouth of Weir River, and to remove the ledge near the wharf.

The total appropriations and allotments for this work to date are $21,067.89, of which $19,523.83 had been expended to June 30, 1891.

On June 30, 1891, the channel was at least 150 feet wide, 9½ feet deep at mean low water, except over a ledge uncovered by the dredging near the wharf, which is estimated to contain 150 cubic yards.

No operations were in progress during the fiscal year and the condition of the improvement at the date of this report is the same as on June 30, 1891.

Tonnage of the channel in—	Tons.
1874	390,226
1889	654,920
1890	703,340
1891	800,000

5. CHANNEL BETWEEN NIXS MATE AND LONG ISLAND.

This is a channel through the bar which extends from the north head of Long Island to Nixs Mate Shoal. Previous to the improvement there was 4½ feet depth of water on the bar at mean low tide.

The project for the improvement was adopted in 1883. It was to dredge a channel 200 feet wide, 12 feet deep at mean low water, and about 550 feet long. In 1887 it was recommended that the axis of the cut be shifted 30 degrees to the westward and that it be widened to 300 feet, 15 feet deep at mean low water. The original project was estimated to cost $9,000. The project of 1887 was estimated to cost $25,000 additional. No specific appropriation has been made for this work. The expenditures on it to June 30, 1891, from the appropriations for improving Boston Harbor were $9,709.77.

On June 30, 1891, the project of 1883 had been completed, and a contract was in force to complete the project of 1887.

Operations under this contract were commenced in September, 1891, and completed in January, 1892. Seventy thousand six hundred and seventy-four cubic yards were dredged at a cost of $15,273.20.

At the date of this report the channel is 300 feet wide, 15 feet deep at mean low water.

6. BROAD SOUND.

An obstruction called Barrel Rock, lying on the north side of the Broad Sound Channel, was removed in 1869. It contained 116 cubic yards.

Recapitulation of amounts which could be expended to advantage during the fiscal year ending June 30, 1894.

Extension of Point Allerton sea wall	$15,000
Sea wall for Georges Island	35,000
Sea wall for Governors Island	80,000
Widening of Main Ship Channel at Upper Middle	160,000
Completion of Fort Point Channel	60,000
Total	350,000

The several works completed and projected for the improvement of this harbor are located in the collection district of Boston and Charlestown, Mass. Boston is the port of entry.

The accompanying commercial statistics for the fiscal year ending June 30, 1892, have been furnished by the collector of customs at Boston, Mass.

The dates and amounts of appropriations for this work are as follows:

Act of—		Act of—	
March 2, 1825	$52,972.56	July 12, 1866	$75,000.00
March 19, 1828	2,000.00	March 2, 1867	375,000.00
May 23, 1828	87,000.00	July 11, 1870	100,000.00
March 2, 1829	7,310.54	March 3, 1871	100,000.00
March 2, 1831	5,000.00	June 10, 1872	75,000.00
February 24, 1832	9,000.00	March 3, 1873	150,000.00
March 2, 1831	12,390.00	June 23, 1874	100,000.00
July 3, 1832	60,000.00	March 3, 1875	100,000.00
March 3, 1841	1,500.00	August 14, 1876	50,000.00
August 31, 1842	2,000.00	June 18, 1878	55,000.00
July 4, 1836	15,000.00	March 3, 1879	50,000.00
July 7, 1838	7,353.00	June 14, 1880	75,000.00
March 3, 1841	1,000.00	March 3, 1881	100,000.00
March 3, 1843	16,000.00	August 2, 1882	96,500.00
July 2, 1864	10,000.00	July 5, 1884	5,000.00
February 28, 1865	3,000.00	August 5, 1886	56,250.00
June 12, 1866	50,000.00	August 11, 1888	125,000.00
July 20, 1848	40,000.00	September 19, 1890	145,000.00
August 30, 1852	30,000.00		
July 2, 1864	40,000.00	Total	2,304,276.10
February 28, 1865	20,000.00		

Appropriations made since 1866 have been expended in accordance with the recommendations of the United States commissioners whose labors terminated during that year, for both preservation and improvement of the harbor.

Money statement.

July 1, 1891, balance unexpended		$156,826.12
June 30, 1892, amount expended during fiscal year		68,901.61
July 1, 1892, balance unexpended		87,924.51
July 1, 1892, outstanding liabilities	$5,992.34	
July 1, 1892, amount covered by uncompleted contracts	23,287.62	
		29,279.96
July 1, 1892, balance available		58,644.55
Amount appropriated by act approved July 13, 1892		300,000.00
Amount available for fiscal year ending June 30, 1893		358,644.55
Amount (estimated) required for completion of existing project		50,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging from Boston Harbor, Massachusetts, opened December 10, 1891, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidders.	Price bid for— Dredging, per cubic yard scow measurement.	Price bid for— Removal of bowlders over 6 tons weight.	Total number of yards at price.	Amount of contract.	Remarks.
1	Metropolitan Dredging Company, Lynn, Mass.	$0.30	$10	120,000	$36,000	
2	Charles H. Souther, Boston, Mass.	.17⅞		201,398	36,000	
3	Augustus R. Wright, Portland, Me	.17	4	211,764	36,000	Lowest bid.

The contract was awarded to Mr. Augustus R. Wright with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

Amount of revenue collected—1890, $19,407,928.57; 1891, $18,038,772.34; 1892, $14,491,854.98.

Shipping.	1890.		1891.		1892.	
Entrances:	*No.*	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
Foreign	2,251	1,404,867	2,474	1,502,759	2,262	1,663,711
Clearances:						
Foreign	2,267	1,208,505	2,376	1,226,378	2,181	1,406,650

	1890.	1891.	1892.
Importations:			
Merchandise	$62,876,666	$71,212,614	$71,780,489
Coin and bullion	49,314	10,238	12,944
Exportations:			
Foreign merchandise	836,989	300,564	564,140
Domestic merchandise	70,264,955	76,731,823	86,610,057
Coin and bullion	....	1,250,000	....

REPORTS UPON ENLARGEMENT OF MAIN CHANNEL OF BOSTON HARBOR, MASSACHUSETTS, SUBMITTED TO UNITED STATES SENATE, IN COMPLIANCE WITH SENATE RESOLUTION OF APRIL 18, 1892.

[Printed in Senate Ex. Doc. No. 83, Fifty-second Congress, first session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., April 19, 1892.

SIR: I have to acknowledge receipt of resolution of the 18th instant of the Senate of the United States directing the Secretary of War "to inform the Senate at his earliest convenience what would be the cost of deepening the main channel of Boston Harbor to a uniform depth of 30 feet, and a uniform width of 1,000 feet, and also to give to the Senate any facts in his possession, or that of the Chief of Engineers, showing the desirability of such improvement."

In reply to the reference of the resolution to this office for report, I have the honor to inclose a copy of letter of December 23, 1891, with map,* from Lieut. Col. S. M. Mansfield, Corps of Engineers, submitting estimate amounting to $1,500,000 for increasing the depth of channel to Boston Harbor to 30 feet at mean low water as indicated on the accompanying map. The width of the proposed channel is limited to 625 feet at the "Narrows."

Lieut. Col. Mansfield, in presenting this estimate, states that "the inadequate depth of water in the channel causes nearly all of the deep-draft vessels to anchor outside Boston Light, and await the tide, so that delays of from three to nine hours in the delivery of mails, passengers, and the other concomitants of commerce are not infrequent."

The resolution of the Senate is herewith returned.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brigadier-General, Chief of Engineers.

Hon. S. B. ELKINS,
Secretary of War.

---

* Omitted.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., December 23, 1891.

GENERAL: The project for the improvement of Boston Harbor, Massachusetts, which was adopted in 1867, proposed to obtain a channel 1,000 feet wide, except at the "Narrows" where but 625 feet width could be obtained, 23 feet deep at mean low water.

This project has been essentially completed. Twenty-three feet at mean low water is reduced at "spring" tides to 20½ feet, and allowing but 6 inches for drag, the channel accommodates at such times vessels drawing not to exceed 20 feet.

At the date of the adoption of the project this depth was perhaps ample, but the size, and especially the draft, of seagoing vessels has steadily advanced, so that now vessels drawing 26, 27, and 28 feet are not uncommon.

The inadequate depth of water in the channel causes nearly all of the deep-draft vessels to anchor outside Boston Light and await the tide, so that delays of from three to nine hours in the delivery of mails, passengers, and other concomitants of commerce are not infrequent.

To remove this obstruction to navigation I have the honor to recommend that the main ship channel in Boston Harbor be deepened to 30 feet at mean low water, as indicated on the accompanying tracing.

The cost of this improvement is estimated to be as follows:

Dredging 4,438,000 cubic yards, at 30 cents per cubic yard	$1,331,400
Contingencies, removal of ledges, etc., uncovered by dredging	168,600
Total	1,500,000

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

B 12.

IMPROVEMENT OF WEYMOUTH RIVER, MASSACHUSETTS.

Weymouth (Fore) River, Massachusetts, tributary to Hingham Bay, Boston Harbor, on the southwest, is one of the most important water courses on the south coast of Massachusetts Bay. It is navigable at low water for vessels not exceeding 18 feet draft, for 4 miles from its mouth; and for a further distance of 3 miles, to the head of navigation, at least 3 feet depth is found at mean low water.

The original project for its improvement was submitted December 2, 1889. It was based on the survey provided for by the act of August 11, 1888, and proposed to improve the natural channel of the river by dredging, so that 6 feet depth at mean low water can be carried to the head of navigation in a channel 100 feet wide to near the wharves at Weymouth Landing, thence to Braintree Bridge, 80 feet wide, and above the bridge, 50 feet wide, with increased width at each turn to facilitate the movement of vessels. The total length of channel to be improved is 700 feet, approximately, and the cost is estimated to be $10,000.

The total appropriations for this improvement to date are $10,000, by act of September 19, 1890.

The expenditures to June 30, 1891, were $4,468.46, the resulting improved channel being 5,000 feet long, 40 feet wide, 6 feet deep at mean low water; and work was in progress under a contract with Mr. Augustus R. Wright to dredge 24,000 cubic yards.

This contract was satisfactorily completed in July, 1891; 23,974 cubic yards were removed, and at the date of this report the improved channel is 6 feet deep at mean low water, 40 feet wide to Braintree Bridge, and 25 feet wide thence to the head of navigation.

The amount required to complete the improvement is $30,000, all of which could be expended during the fiscal year ending June 30, 1894.

Weymouth River, Massachusetts, is in the collection district of Boston, Mass., of which Boston is the port of entry. The nearest light-house is on Long Island, Boston Harbor, Massachusetts.

Commercial statistics are included in Boston Harbor, Massachusetts.

Money statement.

July 1, 1891, balance unexpended	$5,531.54
June 30, 1892, amount expended during fiscal year	5,531.54
Amount appropriated by act approved July 13, 1892	10,000.00
Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

B 13.

IMPROVEMENT OF HARBOR AT HINGHAM, MASSACHUSETTS.

Hingham Harbor is situated in the southern part of Hingham or Hull Basin, which comprises all that part of Boston Lower Harbor south of Nantasket Roads.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for 1888, Part I, page 456.

The harbor covers an area of 1 square mile, and has extensive mud flats, bare at low tide.

The mean rise or fall of the tide is 9.4 feet.

The channel leading to Hingham, south of Ragged and Sailors Islands, was before improvement very narrow and crooked, and obstructed by sunken rocks and shoals. Its least width was 30 feet and least depth 4 feet at mean low water.

The object of its improvement is to widen and deepen the natural channel from deep water near the head of the harbor to the steamboat wharf, a distance of 2,500 feet.

The original project for improvement was submitted December 23, 1874.

It provided for an improved channel on the east side of Sailors Island, past the west side of Beacon to the Hingham wharf, 100 feet wide and 8 feet deep at mean low water, at an estimated cost of $11,000.

This project was modified January 20, 1885, when it was proposed to deepen the improved channel to 10 feet at mean low water and to remove a mid-channel ledge lying between Chandler and Ragged islands, measuring 128 cubic yards, at an estimated cost of $18,700.

The total amount appropriated for this harbor to date is $26,000.

The total expenditures to June 30, 1891, were $25,088.35.

On June 30, 1891, the revised project for the improvement of the harbor had been completed, with the exception of the removal of the mid-channel ledge between Chandlers and Ragged islands.

The condition of the improvement at the date of this report is the same as on June 30, 1891.

The channel is now 100 feet wide, 10 feet deep at mean low water.

To complete the improvement will require an appropriation of $3,000, all of which could be expended to advantage during the year ending June 30, 1894.

The benefit to be expected by the completion of this improvement is a more convenient and safe navigation of the channel leading to the town wharves.

Hingham Harbor is in the collection district of Boston, Mass. The nearest light-house is the Narrows Light, on the main ship channel in Boston Harbor, distant about 5 miles.

The dates and amounts of appropriations for this work are as follows:

Allotted from appropriation for Boston Harbor, act of March 3, 1875	$10,000
Act of—	
August 5, 1886	6,000
August 11, 1888	5,000
September 19, 1890	5,000
Total	26,000

Money statement.

July 1, 1891, balance unexpended	$911.65
July 1, 1892, balance unexpended	911.65
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	3,911.65

COMMERCIAL STATISTICS.

Tonnage of the harbor in—	Tons.
1884	273,090
1889	569,070
1890	600,000

B 14.

IMPROVEMENT OF HARBOR AT SCITUATE, MASSACHUSETTS.

Scituate Harbor is on the west shore of Massachusetts Bay, 14 miles from either Boston or Plymouth light-houses, and just southwest of the direct sailing course of all ocean-going vessels entering Boston Harbor.

Before improvement the harbor had a low-water area of 57 acres approximately, more than 6 acres of which had a depth of at least 3 feet at mean low water. It was entirely open to the action of east winds, and the entrance was obstructed by many sunken bowlders. The depth on the bar was about 2½ feet at mean low water. The mean rise or fall of the tide is 9.8 feet.

A plan of the harbor, showing the proposed improvement, was published in the Annual Report of the Chief of Engineers for 1881, Part I, page 522.

The object of the improvement is to create a harbor of refuge for vessels bound to Boston that are too far south of their course to clear the dangerous ledges near Minots Light-house.

The project for the improvement adopted in 1881 is to build two rubblestone breakwaters converging from opposite shores, and to dredge an anchorage basin with channels connecting with the sea and the town wharves.

The north breakwater, from Cedar Point, is to be 800 feet long, and the south breakwater, from the point of the first cliff, is to be 730 feet. Both breakwaters are to be 20 feet wide on top and 4 feet above mean high water, except at their outer ends, which are to be built 6 feet higher, to serve as sites for entrance beacons; the anchorage basin to be 30 acres in area, approximately; the entrance channel to be 2,700 feet long and 300 feet average width.

The estimated amount of dredging (including the entrance channel) was 500,000 cubic yards, to give a depth of 15 feet in the entrance channel; 12 to 15 feet between the breakwaters; 12 feet immediately in rear of the south breakwater, and 10 feet for the anchorage basin, at mean low water.

The estimated cost of the breakwaters was $100,000, and of the dredging, $190,000, a total of $290,000.

The total amount appropriated for this work to date is $63,680.

The amount expended to June 30, 1891, was $52,918.73.

The condition of the improvement on June 30, 1891, was as follows:

The north breakwater was 720 feet long, of full width and height; the entrance channel was 100 feet wide, 1,600 feet long, and 5 feet deep at mean low water. Nothing had been done on the south breakwater.

A portion of the beach between Cedar Point and the mainland was protected by a brush and stone bulkhead 450 feet long, in front of which was a stone apron 10 feet wide, 385 feet long. All known bowlders obstructing the entrance of the harbor were removed.

The channel leading from the anchorage basin to the town wharves was 25 feet wide, 1 foot deep at mean low water.

A contract was in force with Mr. Augustus R. Wright to dredge 30,000 cubic yards at 32½ cents per yard from the channel connecting the anchorage basin with the town wharves.

Operations were commenced under this contract in July, 1891, and satisfactorily completed in October, 1891.

The condition of the improvement on June 30, 1892, is as follows: The north and south breakwaters, the entrance channel, and the anchorage basin are essentially the same as on June 30, 1891. The channel connecting the anchorage basin with the town wharves is 3 feet deep at mean low water and 100 feet wide, except at the upper end, where for a distance of 75 feet it averages only 50 feet in width.

The amount required to complete the improvement is $227,500. Of this amount $50,000 could be expended during the fiscal year ending June 30, 1894, in building the south breakwater.

Scituate is in the collection district of Plymouth, Mass. The nearest port of entry is Plymouth, Mass. The nearest light-house is Minots Light, about 5 miles distant.

The accompanying commercial statistics have been furnished by the collector of customs at Plymouth, Mass.

The dates and amounts of appropriations for this work to date are as follows:

Act of—	
March 2, 1829	$180
August 30, 1852	1,000
June 14, 1880	7,500
March 3, 1881	10,000
August 2, 1882	10,000
July 5, 1884	10,000
August 5, 1886	$10,000
August 11, 1888	5,000
September 19, 1890	10,000
Total	63,680

Appropriations since 1880 have been expended in accordance with present approved project.

Money statement.

July 1, 1891, balance unexpended	$10,761.23
June 30, 1892, amount expended during fiscal year	10,611.23
July 1, 1892, balance unexpended	150.00
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	10,150.00
Amount (estimated) required for completion of existing project	217,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Amount of revenue collected, 1890, none; 1891, none; 1892, $31.50.

Shipping.	1890.		1891.		1892.	
	No.	Tons.	No.	Tons.	No.	Tons.
Entrances:						
Foreign	......	....	......	....	1	100
Domestic	18	2,800	38	3,800	29	3,000
Clearances:						
Foreign	......	....	......	....	1	....
Domestic	18	2,800	38	3,800	29	....

Imported.	1890.	1891.	1892.
Coal .... tons	1,800	2,500	3,000
Lumber .... feet	1,600	4,000	1,500,000
Miscellaneous:			
Lime .... casks	....	....	250
Bricks	....	....	25,000

Coasting schooners drawing from 8 to 10 feet frequent the harbor.

B 15.

IMPROVEMENT OF HARBOR AT PLYMOUTH, MASSACHUSETTS.

Plymouth Harbor is situated 30 miles south of Boston. Its outer anchorage, the "Cow Yard," is common to Plymouth, Kingston, and Duxbury and is the only refuge for seagoing vessels from northeasterly gales when caught between Boston and Provincetown, a distance of about 75 miles, following the coast line. The entrance to this outer anchorage is direct, unobstructed, and of ample width, and sufficiently deep for the wants of commerce. The anchorage is capacious and has good "holding ground," but the extensive tidal basins inside of it give rise to strong variable currents across it.

The inner or harbor proper is formed by Long Beach, a narrow, low sand spit 3 miles long, which runs generally parallel to the mainland and about a mile from it.

The harbor contains 2,000 acres, almost all of which is dry at low tide. A few narrow, crooked shallow channels traverse these flats. These channels join about the center of the harbor, opposite the town wharves, and form the main ship channel, 150 feet wide, approximately, and 10 feet deep at mean low water, which runs directly behind the northern half of Long Beach to the outer anchorage.

The maintenance of this inner harbor and channel depends on the preservation of Long Beach.

Before improvement about 6 inches depth of water could be carried to the town wharves at low tide.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for the year 1888, Part I, page 460.

Previous to 1875 the project was a general one and had for its object the preservation only of Long Beach. From the nature of the work it can at no time be considered completed and small annual appropriations are necessary to repair any damages done by storms. The various devices employed for this purpose are described in the Annual Report of the Chief of Engineers for 1877, all of which have been remarkably successful.

The project for the improvement of the harbor was first adopted in 1875. It provided for dredging a channel from the town wharves to the main ship channel, 2,286 feet long, 100 feet wide, and 6 feet deep at mean low water. This project was modified in 1877 so as to include the dredging of a basin 866 feet long, 150 feet wide, and 8 feet deep, directly in front of the town wharves.

In 1884 and 1885 it was proposed to deepen the proposed channel and basin to 9 feet at mean low water and to make the channel 150 feet wide.

The modified project of 1884 required the excavation of 81,000 cubic yards (scow measurement) and was originally estimated to cost $27,000. This estimate was revised in 1885 in accordance with the low prices then current for dredging, and the cost was then estimated to be $22,500.

From 1824 to date the amount appropriated for this improvement is $170,266.90, of which there had been expended to June 30, 1891—

For beach protection	$127,553.77
For dredging	42,713.13
Total	170,266.90

On June 30, 1891, the improved channel was in good order, 115 feet wide, 9 feet deep at mean low water. The basin was 800 feet long, with an average width of 150 feet, 9 feet deep at mean low water. Some repairs were needed to the bulkheads protecting Long Beach and dredging operations were in progress under a contract with the National Dredging Company to dredge 18,000 cubic yards from the channel and basin.

The contract for dredging was completed in July, 1891; 18,504 cubic yards were removed, and the channel was widened to 130 feet, 9 feet deep at mean low water, and the basin completed as proposed.

During the year about 1,300 feet of the bulkheads protecting Long Beach were repaired.

At the date of this report the improved channel and basin are in good order; the channel is 2,286 feet long and 130 feet wide; the basin, 866 feet long, 150 feet wide, both 9 feet deep at mean low water. The existing bulkheads protecting Long Beach are in fair order, but the southern part of the beach, for a distance of 5,000 feet, has for some years been growing lower and narrower, and this part of it will soon require additional protection.

To complete the project will require an appropriation of $9,500, all of which could be expended during the fiscal year ending June 30, 1894.

A small sum should always be available for the harbor to immediately repair any damages made by storms to Long Beach. These necessary repairs have in the last twenty years averaged $1,500.

The prospective benefits to commerce are increased facilities and safety in navigating the improved channel.

Plymouth Harbor is in the collection district of Plymouth, Mass., of which Plymouth is the port of entry.

The nearest light-houses are the Plymouth (Gurnet) lights, about 5 miles from Plymouth, and Duxbury Pier Light, about 2 miles distant.

The accompanying commercial statistics for the fiscal year ending June 30, 1892, have been furnished by the collector of customs at Plymouth, Mass.

The dates and amounts of appropriations for this work are as follows:

Act of—		Act of—	
May 26, 1824	$20,000.00	March 3, 1873	$3,000.00
March 3, 1825	5,712.00	June 23, 1874	5,000.00
March 25, 1826	13,184.90	March 3, 1875	10,000.00
April 23, 1830	1,850.00	June 18, 1878	5,000.00
March 2, 1831	2,820.00	March 3, 1879	3,500.00
July 3, 1832	2,500.00	June 14, 1880	10,000.00
March 2, 1833	600.00	March 3, 1881	10,000.00
June 28, 1834	2,000.00	August 2, 1882	14,000.00
March 3, 1835	700.00	July 5, 1884	10,000.00
July 2, 1836	500.00	August 5, 1886	6,000.00
July 7, 1838	2,400.00	August 11, 1888	6,000.00
August 31, 1852	5,000.00	September 19, 1890	8,000.00
July 11, 1870	10,000.00		
March 3, 1871	10,000.00	Total	170,266.90
June 10, 1872	2,500.00		

Money statement.

July 1, 1891, balance unexpended	$9,171.39
June 30, 1892, amount expended during fiscal year	6,878.74
July 1, 1892, balance unexpended	2,292.65
July 1, 1892, outstanding liabilities	299.35
July 1, 1892, balance available	1,993.30
Amount appropriated by act approved July 13, 1892	9,500.00
Amount available for fiscal year ending June 30, 1893	11,493.30

COMMERCIAL STATISTICS.

Amount of revenue collected, 1890, $108,174.31; 1891, $73,536.29; 1892, $73,808.36.

Shipping.	1890.		1892.	
	No.	*Tons.*	*No.*	*Tons.*
Entrances:				
Foreign	2	1,864	2	196
Domestic	124	18,104	103	....
Clearances:				
Foreign	10	1,443	9	1,817
Domestic	120	17,148	......	....

Imported.		1890.	1891.	1892.
Coal	tons	23,500	18,065	16,861
Iron	do	1,325	1,973	1,143
Lumber	feet	9,800	6,160	3,303,463
Sand	tons	....	....	295
Miscellaneous	do	*975	*330	†1,145

* Miscellaneous. † Steel.

The vessels frequenting the harbor are coasting schooners drawing from 7 to 15 feet.

B 16.

IMPROVEMENT OF HARBOR AT WELLFLEET, MASSACHUSETTS.

Wellfleet Harbor is situated on Cape Cod Bay, 12 miles southeast of Provincetown Harbor.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for the year 1888, Part I, page 478.

The harbor consists of an outer anchorage south of Smalleys Bar, and an inner harbor north of the same bar.

The outer anchorage is sufficiently capacious, free from obstructions, and protected to meet the present demands of commerce; but the inner harbor, although capacious and perfectly protected, has no low-water navigable connection with the town wharves.

It is 4,200 feet from the 6-foot contour to the wharves, and not to exceed 6 inches draft can be carried to them at mean low water.

The original project for the improvement of this harbor was submitted November 3, 1871. It was based on the survey provided for in the river and harbor act of January 31, 1871.

It proposed to dredge two channels, each 150 feet wide and 4 feet deep at mean low water, one 2,060 feet long, to reach "Central" and "Commercial" wharves, and one 1,400 feet long, to reach "Mercantile" Wharf. It was also proposed to remove 204 cubic yards of sunken rocks. The cost of this project was estimated to be $30,000.

On November 28, 1887, a revised project was submitted. It was based on the survey provided for in the river and harbor act of August 5, 1886. It proposed to dredge a channel from the "Deep Hole" to the town wharves, 6 feet deep at mean low water, 100 feet wide, and 4,200 feet long, at an estimated cost of $24,000.

The total appropriations for this harbor to date have been $16,000.

By the river and harbor act of June 10, 1872	$5,000
By the river and harbor act of August 11, 1888	7,000
By the river and harbor act of September 19, 1890	4,000
Total	16,000

The total amount expended to June 30, 1891, was $11,350.37, and the condition of the improvement was as follows: "Mayo," "Bay," "Lobster," and "Lumpfish" rocks had been removed, and a channel had been dredged from the "Deep Hole" to the town wharves, 4,200 feet long, 4 feet deep at mean low water, and 25 feet wide. Opposite the town wharves the channel was enlarged to 75 feet wide, to facilitate the docking of vessels.

The act of September 19, 1890, appropriated $4,000 to continue this improvement. No appreciable benefit to commerce would result by the expenditure of this amount, and it is to be retained in the Treasury until additional funds are provided.

To complete the improvement will require an appropriation of $22,000, all of which could be expended to advantage during the fiscal year ending June 30, 1894.

The accompanying commercial statistics for the fiscal year ending June 30, 1892, have been furnished by the collector of customs at Barnstable, Mass.:

Wellfleet is in the collection district of Barnstable, Mass., of which Barnstable is the port of entry. The nearest light-house is Mayo Beach Light.

Money statement.

July 1, 1891, balance unexpended	$4,649.63
July 1, 1892, balance unexpended	4,649.63
Amount (estimated) required for completion of existing project	22,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	22,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

Amount of revenue collected, 1890, $253.35; 1891, $231.40; 1892, $91.60.

Shipping.	1890.		1891.		1892.	
	No.	Tons.	No.	Tons.	No.	Tons.
Entrances:						
Foreign	......	......	......	......	......	......
Domestic	9	504	......	......	......	......
Clearances:						
Foreign	......	......	......	......	......	......
Domestic	1	74	1	74	......	......

Imported.	1890.	1891.	1892.
	Tons.	Tons.	Tons.
Coal	1,250	1,250	1,200
Lumber	300	500	......
Merchandise	......	......	200
Miscellaneous	966	......	100

Vessels drawing from 6 to 12 feet frequent the harbor.

B 17.

IMPROVEMENT OF HARBOR AT PROVINCETOWN, MASSACHUSETTS.

Provincetown Harbor is situated at the extremity of Cape Cod, about 40 miles southeast from Boston Light.

It is one of the most valuable harbors of refuge on the Atlantic coast. The entire commerce of New England and a very large local fishing interest are directly benefited by its maintenance, which depends entirely on the preservation of the sandy beaches which inclose it.

Since 1826 the project has been a general one, and provides for the preservation of the harbor by building dikes, bulkheads, and sand-catches, and extensive planting of beach grass to repair or prevent storm damages to the beaches.

From the nature of the work it can at no time be considered completed.

A full history of the improvements will be found in the Annual Reports of the Chief of Engineers for the years 1876, 1879, and 1886. A special dike across House Point Island Flats, to be built contingently, was recommended in the Annual Report for 1886. A plan of the harbor was published in the Annual Report of the Chief of Engineers for 1886.

The total appropriations or allotments for this work to date have been $151,418.44.

The amount expended to June 30, 1891, was $142,588.47.

The condition of the improvement on that date was as follows:

Long Point.—This long, narrow, low point forms the southeastern limit of the harbor. Its northerly end was fully protected from easterly storm action; but the northwestern part of the point, opposite the fog-signal station, has for some time been abraded by storms. During the fiscal year the breakwater protecting the easterly shore was extended 150 feet to the south and west, and should be extended 100 feet farther to fully secure the light-house tract.

The northwestern part of Long Point, between a point 2,000 feet west of Wood End Light and Abel Hill Dike, was narrow and low, and needed additional protection, which was being effected by the construction of a bulkhead on the inside of the point, starting about 2,000 feet west of Wood End Light, and extending westward 2,000 feet, approximately. During the fiscal year this bulkhead was completed. A total length of 3,213 feet, including spurs, was built.

Abel Hill Dike.—This dike was built to prevent the rush of water from Lancey's Harbor over House Point Island Flats into the main harbor. The rapid wearing away of the southern sandspit that forms Lancey's Harbor had threatened to make a breach through the beach south of the dike. To guard against this, brush and wooden sand-catches had been built on the outer beach opposite the west end of the dike. They were all in good order.

House Point Island Flats.—These flats remained essentially unaltered from the condition shown by the last survey, and as stated in the Annual Report for 1887, it still appears unnecessary to commence the dike projected to be built across these flats. The most of the grass planted during the year 1888 had rooted, and was growing at the date of this report.

Beach Point, High Head Dike, and Cove Section.—These works were all in good order. With the exception of the building of the new bulkhead on Long Point, the extension of the Long Point Breakwater, and some minor repairs to the sand-catches near Abel Hill Dike, no operations were in progress during the fiscal year, and at the date of this report all the works of preservation are in good order.

The nature of the works of preservation of the harbor requires a small sum to be always available for immediate repairs. Such necessary repairs have averaged $1,500 per annum.

The prospective benefit to commerce is the preservation of an important harbor of refuge.

Provincetown is a port of entry in the collection district of Barnstable, Mass. The nearest-light houses are Wood End and Long Point lights.

The accompanying commercial statistics have been furnished by the deputy collector at the port of Provincetown, Mass.

The dates and amounts of appropriations for this work are as follows:

Act of—		Act of—	
May 19, 1826	$3,500.00	June 23, 1874	$6,000.00
March 2, 1829	3,500.00	March 3, 1875	5,000.00
March 2, 1831	2,050.00	August 14, 1876	4,000.00
March 3, 1832	4,600.00	June 18, 1878	1,000.00
June 28, 1834	4,400.00	March 3, 1879	1,000.00
March 3, 1835	4,400.00	June 14, 1880	500.00
July 2, 1836	4,400.00	March 3, 1881	5,000.00
July 7, 1838	4,500.00	August 2, 1882	5,000.00
August 30, 1852	5,000.00	July 5, 1884	2,000.00
June 23, 1866	43,068.44	August 5, 1886	3,000.00
July 28, 1866	8,000.00	August 11, 1888	7,000.00
March 3, 1871	6,000.00	September 19, 1890	7,500.00
June 10, 1872	5,000.00		
March 3, 1873	6,000.00	Total	151,418.44

Money statement.

July 1, 1891, balance unexpended	$8,832.97
June 30, 1892, amount expended during fiscal year	5,049.62
July 1, 1892, balance unexpended	3,783.35
Amount appropriated by act approved July 13, 1892	1,500.00
Amount available for fiscal year ending June 30, 1893	5,283.35

COMMERCIAL STATISTICS.

Amount of revenue collected, 1890, $111.58; 1891, $1,932.75; 1892, $571.47.

Shipping.	1890.		1891.		1892.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
Entrances:						
Foreign	27	4,462	55	9,232	44	6,558
Domestic			16	2,000	13	756
Clearances:						
Foreign	20	1,924	27	5,500	26	2,919
Domestic			10	2,000	18	4,466

Imported.	1890.	1891.	1892.
	Tons.	*Tons.*	*Tons.*
Coal		5,000	6,000
Wood			300
Lumber		2,000	1,140
Salt			500
Ice			80
Fish			1,500
Miscellaneous	1,000	9,300	740

All classes and nationalities of vessels visit the harbor for shelter or with cargo. Four thousand vessels visited the harbor during the year.

B 18.

IMPROVEMENT OF HARBOR AT CHATHAM, MASSACHUSETTS.

Chatham Harbor is at the eastern end of Nantucket Sound, about 15 miles east of Hyannis, Mass. Its outer anchorage, known as Chatham Roads, is a capacious, deep, unobstructed harbor of refuge from northerly and easterly gales.

The inner harbor, locally known as "Stage" Harbor, is small, but well land-locked. It is about one-half mile long, 500 to 600 feet wide, and has 8 to 12 feet depth at mean low water. Its entrance is obstructed by three bars, on which the depth at mean low water does not exceed 4 feet. The mean rise or fall of the tide is 5 feet.

The project for the improvement of the inner harbor was submitted December 19, 1890, and was based on a survey made in October, 1890. It proposed to dredge a channel 6 feet deep at mean low water through the three obstructing bars, 100 feet wide at the inner bar, 150 feet wide at the middle bar, and 200 feet wide at the outer bar, at an estimated cost of $10,000.

But one appropriation has been made for this improvement, viz, by the act of September 19, 1890, $5,000.

This sum it is proposed to expend in dredging a channel 100 feet wide and 6 feet deep through the three bars.

Bids for this work were invited by public advertisement, dated January 10, 1891, and the proposals received were rejected as excessive.

The work was again advertised under date of July 10, 1891, and on August 10, 1891, the two bids received were opened. An abstract of them will be found in the annexed table.

The lowest bid was not in accordance with the specifications and was rejected. A contract was entered into with Mr. Charles W. Anthony, of Fall River, Mass., on August 26, 1891.

Operations under this contract were commenced in October, and the work was satisfactorily completed in December, 1891. Eight thousand seven hundred and ninety-four cubic yards of material were removed from the middle and inner bars, and at the date of this report the improved channel across them is 6 feet deep at mean low water and 100 feet wide. At least 5 feet at mean low water can now be carried into the inner harbor.

To complete the improvement will require an appropriation of $5,000, all of which could be expended to advantage during the fiscal year ending June 30, 1894.

Chatham Harbor is in the collection district of Barnstable, Mass., of which Barnstable is the port of entry; the nearest light-house is Hardings Beach Light.

The accompanying commercial statistics have been furnished by the collector at Barnstable, Mass.:

Money statement.

July 1, 1891, balance unexpended	$4,601.19
June 30, 1892, amount expended during fiscal year	4,003.34
July 1, 1892, balance unexpended	597.85
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging from Chatham Harbor, Massachusetts, opened August 10, 1891, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name of bidder and residence.	Price bid per cubic yard. For dredging, scow measurement.	Price bid per cubic yard. For removal of bowlders weighing over 3 tons each.	Total.	Remarks.
1	Chas. W. Anthony, Fall River, Mass	0.41	....	$4,100	Proposes to commence June 1, 1892.
2	Geo. Runyan, Boston, Mass	.40	$8	4,000	

The lowest bid is not in accordance with the specifications. The contract was awarded to Mr. Charles W. Anthony with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

Imported.	1888.	1891.	1892.
	Tons.	*Tons.*	*Tons.*
Coal	2,000	3,000	3,000
Lumber	600	1,000	1,000
Miscellaneous	1,500	....	4,000

Vessels drawing from 5 to 8 feet visit the port in large numbers for shelter or with cargo.

APPENDIX C.

IMPROVEMENT OF RIVERS AND HARBORS ON SOUTHERN COAST OF MASSACHUSETTS, IN RHODE ISLAND, AND ON EASTERN COAST OF CONNECTICUT.

REPORT OF CAPTAIN W. H. BIXBY, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Harbor of refuge at Hyannis, Massachusetts.
2. Harbor of refuge at Nantucket, Massachusetts.
3. Marthas Vineyard inner harbor at Edgartown, Massachusetts.
4. Vineyard Haven Harbor, Massachusetts.
5. Wareham Harbor, Massachusetts.
6. New Bedford Harbor, Massachusetts.
7. Westport Harbor, Massachusetts.
8. Taunton River, Massachusetts.
9. Pawtucket River, Rhode Island.
10. Providence River and Narragansett Bay, Rhode Island.
11. Green Jacket Shoal, Providence River, Rhode Island.
12. Greenwich Bay, Rhode Island.
13. Cove and waterway near Coaster Harbor Island, Rhode Island.
14. Newport Harbor, Rhode Island.
15. Harbor of refuge at Point Judith, Rhode Island.
16. Harbor of refuge at Block Island, Rhode Island.
17. Pawcatuck River, Rhode Island and Connecticut.
18. Harbor of refuge at Stonington, Connecticut.
19. Removing sunken vessels or craft obstructing or endangering navigation.

EXAMINATIONS AND SURVEYS.

20. Menemsha Bight, Massachusetts.
21. Canapitsit Channel, Massachusetts.

ENGINEER OFFICE, U. S. ARMY,
Newport, R. I., July 9, 1892.

GENERAL: I have the honor to submit herewith annual reports on the river and harbor works under my charge at the end of the fiscal year ending June 30, 1892.

At the commencement of the fiscal year these works were in the charge of Maj. W. R. Livermore. They were transferred to me on the 7th December, 1891.

This office has been assisted by Assistant Engineers Edward Parrish, John H. Rostock, and Superintendent Walter C. Simmons.

Very respectfully, your obedient servant,

W. H. BIXBY,
Captain of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

C 1.

HARBOR OF REFUGE AT HYANNIS, MASSACHUSETTS.

The harbor of Hyannis lies on the south shore of the peninsula of Cape Cod, about 15 miles to the westward of the heel of the cape, and is an important harbor of refuge. (For map see page 592, Annual Report of 1884.)

The mean rise and fall of the tide is about 3¾ feet.

ORIGINAL CONDITION.

Before improvement it was an open roadstead, exposed to southerly storms, with depths varying from 10 to 20 feet in the inner harbor.

In the years 1827–1838 a breakwater of riprap granite, 1,170 feet long, was constructed, covering an anchorage of about 175 acres, the entrance to which had a depth of about 15½ feet. In the years 1852–1882 extensive repairs were made in increasing the width of its base and the size of the stone forming its sides and top. About $124,000 was spent on this work, completed in 1882.

PLAN OF IMPROVEMENT.

The depth of water immediately inside the breakwater being insufficient for many vessels that now seek the harbor of refuge, the present project of 1884 for the improvement of the harbor, published in the Report of the Chief of Engineers for 1885, volume 1, pages 560 and 619–621, contemplates dredging the area protected by the breakwater to a depth of 15½ feet at mean low water, at a total cost, as estimated in 1884, of $45,743.20, including the $81.20 then left over from past appropriations.

APPROPRIATIONS.

Upon the present project appropriations have been made as follows: On hand 1884, $81.20; 1886, $10,000; 1888, $10,000; 1890, $8,000. Totals up to June 30, 1891, $28,081.20.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1891.

The total amount expended on the present project (including $3,237.03 of outstanding liabilities) up to June 30, 1891, was $26,066.20. The 15½-foot anchorage area had been increased by about 11 acres, about one-third of the entire area to be dredged.

OPERATIONS DURING THE LAST FISCAL YEAR.

Value of United States plant, $8,400. Including $5.60 of outstanding liabilities the expenses of the year were $2,015.

At the beginning of the last fiscal year work was in progress with plant consisting of the dredge Texas and two scows belonging to the United States, and a hired tug. Six thousand three hundred and sixty cubic yards were excavated during the year, which added about 1.1 acres to the 15½-foot anchorage area. Work in the field was stopped on July 16, and the plant was then transferred to other localities.

This work was in the local charge of Mr. C. O. Abell as superintendent.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the completion of the dredging to a depth of 15½ feet over 23 acres more in the area limited on the west by a line running due north from the western end of the breakwater, and on the north by a line running parallel to the breakwater, and distant 1,500 feet from it, leaving a berm of 100 feet along its northern side.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1893.

It is proposed to apply the balance on hand and the funds asked for to the execution of the project above referred to—of deepening the anchorage area inside the breakwater.

Hyannis Harbor is in the Barnstable collection district, and Barnstable is the nearest port of entry. The amount of revenue collected at Barnstable in the last calendar year was $1,528.78.

The main value of the harbor is for a harbor of refuge. The nearest light-house is Hyannis Light; the nearest fortification is the fort at Clarks Point, New Bedford, Mass.

Money statement.

July 1, 1891, balance unexpended	$5,252.03
June 30, 1892, amount expended during fiscal year	5,246.43
July 1, 1892, balance unexpended	5.60
July 1, 1892, outstanding liabilities	5.60
Amount appropriated by act approved July 13, 1892	6,000.00
Amount (estimated) required for completion of existing project	11,662.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	11,662.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

The commerce arriving and leaving Hyannis Harbor, Massachusetts, by water, during the calendar year ending December 31, 1891, is estimated as follows (based mainly upon reports received from Mr. William Crocker, deputy collector, Hyannis, Mass., and Mr. A. F. Lathrop, Hyannis, Mass.):

Class of goods.	Exports.	Imports.	Total.	Tonnage.
				Tons.
Grain and forage		$86,000	$86,000	4,906
Vegetables and truck	$500		500	30
Fish, oysters, etc	9,175	680	9,855	182
Lumber and products	21,200		21,200	682
Coal, minerals, and products	7,000	60,000	67,000	13,222
General merchandise		10,175	10,175	114
Sundries		800	800	200
Total	37,875	157,655	195,530	19,336

Gain over last year in exports, 1,774 tons; in imports, none known. Transportation lines established during the year, none.

The entrances and departures of vessels from this waterway are estimated as follows:

Vessels.	Number.	Average draft.	Average tonnage.
Steam:		*Feet.*	*Tons.*
Freight and passenger	19	8½	375
Freight mainly	50	11½	800
Passenger mainly	10	8	200
Fishing	39	10	225
Tugs	310	10	100
Pleasure boats	500	2½	15
Sail:			
Freight	2,000	11½	300
Fishing boats	315	3	8
Pleasure, large	150	10	85
Pleasure boats, small	200	3½	10

C 2.

HARBOR OF REFUGE AT NANTUCKET, MASSACHUSETTS.

Nantucket Harbor is the only one between the harbors of Marthas Vineyard (Vineyard Haven and Edgartown) and Provincetown, a distance of about 100 miles, except the small harbor of Hyannis, on the other (the north) side of Nantucket Sound. The navigation of this sound is intricate and dangerous by reason of numerous shoals. Nantucket Harbor has deep water inside, and the object of the improvement is to make it a harbor of refuge for vessels plying between ports north and south of Cape Cod, estimated to be 30,000 annually. In the memorial to Congress, on which the first appropriation for this harbor of refuge was based, it was stated that more than 500 vessels had been wrecked in the vicinity of the island. (For map of harbor see page 423, Annual Report of 1880, and page 576 of Report of 1885.)

The mean rise and fall of the tide is about 3 feet.

ORIGINAL CONDITION.

Before the commencement of the present work there was a shoal about 1½ miles in width outside the entrance, through which shoal the channel or line of best water was only about 6 feet deep and very crooked and subject to changes in location.

PLAN OF THE WORKS.

The present approved project of 1880 as modified in 1885, is to construct jetties of riprap stone projecting from either side of the present entrance to the harbor, for the purpose of concentrating the strength of the tidal currents and excavating a channel of 15 feet depth by scour, and at the places where the full depth required will not be reached by this means to complete the work by dredging, at a total cost, as estimated in 1885, of $375,000 (see page 434, Annual Report 1880, and pages 575, 576 of 1885). A plan of the works may be found in the Report of the Chief of Engineers for 1885, Part I, page 578.

APPROPRIATIONS.

Upon the present project appropriations have been made as follows: 1880, $50,000; 1881, $25,000; 1882, $25,000; 1884, $10,000; 1886, $15,000; 1888, $20,000; 1890, $25,000. Totals up to June 30, 1891, $170,000.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1891.

The total amount expended on the present project (including $2,613.22 outstanding liabilities) up to June 30, 1891, was $155,385; and the result was the construction of the west jetty to a point 3,955 feet from the shore, and the east jetty to a distance of 834 feet from its initial point on shore, which is the outer end of the middle of the three northwest spurs built on Coatue Beach some years ago, and the foundation was laid and the jetty partially completed for an additional distance of 191 feet. The channel was deepened by scour to 7½ feet. Nearly half the needed work had been done.

OPERATIONS DURING THE LAST FISCAL YEAR.

Value of United States plant, $6,500. Including $113.42 of outstanding liabilities, the expenses of the year were $14,615.

At the beginning of the last fiscal year the work of constructing the east jetty had just been resumed.

During the year 7,146 tons of stone were put in the work, by which a length of about 1,300 feet of the east jetty was built up to the half tide level. This work was done by hired labor and barges and towboats owned and hired by the Government. The stone put in the east jetty was carried to Nantucket Harbor in barges, from whence it had to be lightered over the Coatue Flats; this having been mostly done in the lighters belonging to the Government, which from their light draft were well adapted to this kind of work. The work was discontinued on the 14th of August to await further appropriations.

A light has been maintained on the west jetty during the year except during the last two weeks of June, when, from the exhaustion of the appropriation, it was discontinued.

This work was in the local charge of Mr. C. W. Sherman as superintendent.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the extension of the east jetty, the raising of the west jetty in some places, and the excavation by dredging of so much of the channel as may not be excavated by tidal scour.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1893.

The work has been much delayed heretofore by the scour around the end of the jetty, making it necessary to build it in 15 feet of water instead of in 5. According to the present plan it is proposed to build up a considerable length of the jetty to the half-tide level before completing it to the full cross section. The channel appears to be moving continually to the eastward and deepening slightly from year to year.

It is proposed to apply the balance on hand and the funds asked for to the further construction of the east jetty and raising low places in the west jetty, together with a little dredging, if necessary.

Nantucket is in the Nantucket collection district and is a port of entry. There was no revenue collected in the last calendar year. The value of the harbor is mainly as a harbor of refuge. The nearest light-houses are Nantucket Cliff and Brant Point lights. The nearest fortification is the fort at Clark Point, New Bedford, Mass.

Money statement.

July 1, 1891, balance unexpended	$17,228.22
June 30, 1892, amount expended during fiscal year	17,114.80
July 1, 1892, balance unexpended	113.42
July 1, 1892, outstanding liabilities	113.42
Amount appropriated by act approved July 13, 1892	25,000.00
Amount (estimated) required for completion of existing project	180,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

The commerce arriving and leaving Nantucket Harbor, Massachusetts, by water, during the calendar year ending December 31, 1891, is estimated as follows (based mainly upon reports received from Mr. Joseph W. Clapp, collector of customs, Nantucket, Mass.):

Class of goods.	Exports.	Imports.	Total.	Tonnage.
				Tons.
Tobacco		$36,000	$36,000	75
Rice		960	960	6
Grain and forage		27,200	27,200	612
Live stock and products		9,600	9,600	30
Fish, oysters, etc	$16,350		16,350	73
Lumber and products		10,300	10,300	1,016
Coal, minerals, and products		37,925	37,925	6,301
Fertilizers		350	350	10
Machinery and hardware		10,000	10,000	77
General merchandise		17,650	17,650	225
Sundries		4,800	4,800	1,200
Total	16,350	154,785	171,135	9,625

Gain over last year, none known.
Transportation lines established during the year, none.
The vessels using this waterway are estimated as follows:

Vessels.	Number.	Average draft.	Average tonnage.
Steam—		*Feet.*	*Tons.*
Freight and passenger	1	8	400
Fishing	1		
Pleasure boats	20	4	5
Sail—			
Freight, large	4	8	100
Schooners	102		
Sloops	7		
Pleasure, large	20		
Pleasure boats, small	14		

C 3.

IMPROVEMENT OF MARTHAS VINEYARD INNER HARBOR AT EDGARTOWN, MASSACHUSETTS.

The inner harbor at Edgartown lies in the northern part of the waterway or strait that separates Chappaquiddick Island from the east end of Marthas Vineyard. It extends southward about 1½ miles from Chappaquiddick Point opposite Edgartown, and averages about one-fifth of a mile in width.

This harbor is so completely landlocked as to form a safe harbor of refuge for small vessels, but the contracted width of the entrance and the resulting velocity of the tidal currents make it difficult to pass through. (For map of this harbor see House Ex. Doc. No. 59, of Fifty-first Congress, first session.)

ORIGINAL CONDITION.

The anchorage of this harbor was in 1889 obstructed by a Middle-Ground shoal, carrying only about 6 feet depth of water at low tide.

PLAN OF IMPROVEMENT.

The present approved project of 1889 is to excavate the Middle Ground to a depth of 10 feet at mean low water, at a total cost, as estimated in 1889, of $4,500. (For details see page 588, Annual Report of 1890.)

APPROPRIATIONS.

Under the present project appropriations have been made as follows: 1890, $2,000; total up to June 30, 1891, $2,000.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1891.

The total amount expended on the present project (including $232.75 outstanding liabilities) up to June 30, 1891, was $246, in preparations for active work in the field.

OPERATIONS DURING THE LAST FISCAL YEAR.

Value of United States plant, $0.00. Including $11.39 of outstanding liabilities, the expenses of the year were $1,699.40.

At the beginning of the last fiscal year no work was in progress. On July 16 the United States dredge *Texas* borrowed from a neighboring work, two scows, and a hired tug were transferred from Hyannis to Edgartown, and the work of dredging was commenced on the Middle Ground in the inner harbor and continued until August 5, when it was discontinued, to await further appropriations, the plant being transferred to other work. Fifteen thousand three hundred and eighty-five cubic yards of sand were excavated, completing the dredging over about one-half of the "middle-ground."

This work was in the local charge of Mr. C. O. Abell, as superintendent.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the excavation of the remaining half of the Middle Ground to a depth of 10 feet at mean low water.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1893.

It is proposed to apply the balance on hand to the completion of the project.

Edgartown is in the Edgartown collection district and is a port of entry. The amount of revenue collected there during the last calendar year was $460.10; the nearest light-house is the Edgartown Light; the nearest fortification is the fort at Clark Point, New Bedford, Mass.

Money statement.

July 1, 1891, balance unexpended	$1,986.75
June 30, 1892, amount expended during fiscal year	1,920.76
July 1, 1892, balance unexpended	65.99
July 1, 1892, outstanding liabilities	11.39
July 1, 1892, balance available	54.60
Amount appropriated by act approved July 13, 1892	2,500.00
Amount available for fiscal year ending June 30, 1893	2,554.60

COMMERCIAL STATISTICS.

The commerce arriving and leaving Edgartown Harbor, Massachusetts, by water, during the calendar year ending December 31, 1891, is estimated as follows (based mainly upon reports received from Mr. C. H. Marchant, Edgartown, Mass.):

Class of goods.	Exports.	Imports.	Total.	Tonnage.
				Tons.
Tobacco		$25,200	$25,200	30
Rice		200	200	1½
Grain and forage		55,900	55,900	2,599
Vegetables and truck			1,500	50
Live stock and products	$4,345	10,800	15,145	72
Fish, oysters, etc	58,250	1,250	59,500	847
Lumber and products		128,085	128,085	6,600
Coal, minerals, and products	875	29,495	30,370	4,075
Fertilizers		1,875	1,875	50
Machinery and hardware		182,000	182,000	515
General merchandise		434,500	434,500	4,125
Sundries	13,200	2,000	15,200	2,112
Total	76,670	871,305	949,475	21,076½

Gain over last year, none known.

Transportation lines established during the year, none reported.

No one seemed able to furnish any reliable information as to the number of vessels entering, leaving, or using this harbor.

C 4.

IMPROVEMENT OF VINEYARD HAVEN HARBOR, MASSACHUSETTS.

Vineyard Haven is a deep indentation in the northern shore of the island of Marthas Vineyard, on the southern side of Vineyard Sound. It is triangular in form and faces the northeast. The width of the mouth of the harbor, or the distance between the points of land on the east and west sides of the entrance known as East Chop and West Chop, is about 1¼ miles, and from a line connecting the chops to the narrow southerly end of the harbor, at which is situated the town of Vineyard Haven, the distance is about 1¾ miles. The entire area of the harbor between the shore lines is about 949 acres, of which some 657 acres have a depth of not less than 15 feet. The mean rise and fall of the tide is 1.7 feet.

ORIGINAL CONDITION.

At the mouth of the harbor the wearing away of the chops by the action of the waves in storms has been noted for many years. The former site of a light-house on West Chop has entirely disappeared. The débris is carried by the current into the harbor, where it forms shoals, which are gradually impairing the anchorage capacity, especially in the upper part of the harbor. (For map of harbor, see page 580 of Annual Report of 1887).

PLAN OF IMPROVEMENT.

The present approved projects of 1882 and 1887 contemplate the protection of the chops from the action of the storm waves by the construction of jetties and other works along the shore, at a total cost, as estimated in 1882, of $60,000 (see page 594 of Annual Report of 1882; page 577 of 1887; and page 612 of 1889).

APPROPRIATIONS.

Upon the present project appropriations have been made as follows: 1888, $25,000; 1890, $10,000. Total up to June 30, 1891, $35,000.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1891.

The total amount expended on the present project (including $1,017.14 outstanding liabilities) up to June 30, 1891, was $28,924; by which a wharf and three stone jetties, 200 feet apart and from 80 to 150 feet long, and a temporary railroad track have been built at the West Chop, and one jetty and sea wall have been partly built at the East Chop.

OPERATIONS DURING THE LAST FISCAL YEAR.

Value of United States plant, $4,100. Including $44.69 of outstanding liabilities, the expenses of the year were $6,024.72.

At the beginning of the last fiscal year no work was in progress.

On the suspension of work at Nantucket, August 14, the stone lighters and towboats owned and hired by the Government were transferred to the Vineyard Haven work, and the work of constructing longitudinal walls and jetties along the shore line of the East and West Chops was resumed. Stone was landed at the Government wharf on the West Chop and carried by dump cars to the wall along the shore, the track being extended as the work progressed. On the East Chop the stone was lightered from the harbor by the United States lighter *Ada R. Vrooman*, which is of very light draft, and put directly in the wall. Three thousand three hundred and eighty-six tons of stone were put in the work.

On the West Chop, Jetty No. 1 was extended 146 feet, making its total length 296 feet; the longitudinal wall was extended to a point 400 feet east of Jetty No. 3; and a breakwater 60 feet long was built to the westward of the wharf as a protection to vessels landing stone.

On the East Chop the wall was carried about 300 feet to the eastward and 175 feet to the westward of the jetty in front of the lighthouse.

About half the needed work has been done.

Work was discontinued on September 5 to await further appropriations.

This work was in the local charge of Mr. A. R. Elliot, as superintendent.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the completion of these systems of jetties and sea walls at both chops.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1893.

It is proposed to apply the balance on hand and the funds asked for to continue the work of protection, mainly at the East Chop.

Vineyard Haven is in the Edgartown collection district. Edgartown is the nearest port of entry. The amount of revenue collected at Edgartown in the last calendar year was about $400. The nearest light-houses are those on East and West Chops. The nearest fortification is the fort at Clark Point, New Bedford, Mass.

Money statement.

July 1, 1891, balance unexpended	$7,093.14
June 30, 1892, amount expended during fiscal year	6,997.17
July 1, 1892, balance unexpended	95.97
July 1, 1892, outstanding liabilities	44.69
July 1, 1892, balance available	51.28
Amount appropriated by act approved July 13, 1892	7,500.00
Amount available for the fiscal year ending June 30, 1893	7,551.28
Amount (estimated) required for completion of existing project	17,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	17,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

The commerce arriving and leaving Vineyard Haven Harbor, Massachusetts, by water, during the calendar year ending December 31, 1891, is estimated as follows (based mainly upon reports received from Mr. Edward Lord, Vineyard Haven, Mass.):

Class of goods.	Exports.	Imports.	Total.	Tonnage.
				Tons.
Tobacco		$10,000	$10,000	12
Rice		4,500	4,500	42
Grain and forage		42,300	42,300	2,165
Vegetables and truck	$240		240	12
Live stock and products	3,500	37,000	40,500	179
Fish, oysters, etc	32,500		32,500	500
Coal, minerals, and products		30,000	30,000	6,000
Fertilizers		2,000	2,000	50
Machinery and hardware		5,000	5,000	100
General merchandise		527,750	527,750	4,140
Sundries		5,000	5,000	1,000
Totals	36,240	663,550	699,790	14,200

Gain over last year; none known.

Transportation lines established during the year, none.

The entrances and departures of vessels from this waterway are estimated as follows:

Vessels.	Number.	Average draft.	Average tonnage.
Steam—		*Feet.*	*Tons.*
Freight and passenger	50	12	1,100
Freight mainly	100	16	1,200
Passenger mainly	1,892	10	800
Fishing	30	10	100
Tugs	300	11	200
Pleasure boats	100	9	175
Sail—			
Freight	7,000	15	500
Fishing boats	200	10	150
Pleasure, large	500	10	110
Pleasure boats, small	100	5	40

C 5.

IMPROVEMENT OF WAREHAM HARBOR, MASSACHUSETTS.

This harbor is an estuary at the head of Buzzards Bay. The object of the improvement is to deepen and widen the channel leading from Buzzards Bay to Wareham, the industries of which, and of several towns in the vicinity with which it is connected by rail, are chiefly the manufacture of iron, and depend largely on transportation by water of the material used therein. The commerce of Wareham is carried on in sailing vessels, and the channel is to be made a beating channel for such vessels.

Another object of the improvement is the raising of Long Beach, over which the sands from the bay were washed into the harbor. The mean rise and fall of the tide is 4 feet.

ORIGINAL CONDITION.

Before improvement the ruling depth in the harbor was about 7 feet at mean low water in a narrow and very crooked channel. Long Beach, a narrow sand spit at the mouth of the harbor, was washed and abraded by the waves and currents at high water, and the material was carried into and shoaled the channel inside.

PLAN OF IMPROVEMENT.

The present approved project of 1880, as modified in 1887, provides as follows, at a total cost, as estimated in 1887, of $56,236: A channel 250 feet wide and 10 feet deep at mean low water from Barney Point down to the entrance to the harbor. Above Barney Point the width of the channel is to be 350 feet, with the same depth, 10 feet, as below that point. The plan includes also the raising and strengthening of Long Beach, of which a large portion was submerged at low water, to carry it above the storm waves and currents and to hold it there, in order to prevent the filling of the improved channel above by material abraded from the beach (see page 550 of Annual Report of 1881 and 542 of 1887).

A plat of Wareham Harbor, showing the lines of the channel now being excavated, may be found in the Annual Report of the Chief of Engineers for 1885, Part I, page 586.

APPROPRIATIONS.

Upon the present project, appropriations have been made as follows: 1881, $10,000; 1882, $5,000; 1884, $10,000; 1886, $15,000; 1888, $4,000; 1890; $5,000. Total up to June 30, 1891, $49,000.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1891.

The total amount expended on the present project (including $0.00 outstanding liabilities) up to June 30, 1891, was $44,746.07; and the result was that the channel in the upper part of the harbor had been completed, the approaches had been greatly widened, and their ruling depth increased from 7 to 9 feet; the channel for about one-half its width from Barney Point to Wareham and a portion of Reach No. 9, formerly obstructed by the shoal known as the Middle Ground, had been dredged to 10 feet, and Long Beach had been raised above high-water storm tides and partly protected by catch-sand fences and brush and stonework so as to considerably prevent further wear and further filling of the channel by sand.

OPERATIONS DURING THE LAST FISCAL YEAR.

Value of United States plant, $5,200. Including $144.26 of outstanding liabilities, the expenses of the year were $2,119.37.

At the beginning of the year Mr. J. H. Fenner, of Jersey City, N. J., was under contract to do about $1,760 of dredging, but the time for commencement had been extended until the spring of 1890. The work of actual dredging, under this contract, was commenced June 8, 1892, and was in progress at the close of the fiscal year. During June 7,292 cubic yards of mud and sand were excavated in such way as to widen the channel in its narrowest places above Barney Point.

This work was in the local charge of Mr. C. O. Abell, as superintendent.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the excavation of the channel to its full width and depth down to the deep water above Long Beach, and the further building up of Long Beach by the construction of sand fences.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1893.

It is proposed to apply the balance of the funds on hand to the completion of the channel and to the further building up of Long Beach.

Wareham is in the New Bedford collection district. New Bedford is the nearest port of entry. The amount of revenue collected at New Bedford in the last calendar year was $80,531.48. The nearest light-houses are Bird Island and Wing Neck lights. The nearest fortification is the fort at Clark Point, New Bedford, Mass.

Money statement.

July 1, 1891, balance unexpended		$4,253.93
June 30, 1892, amount expended during fiscal year		1,975.11
July 1, 1892, balance unexpended		2,278.82
July 1, 1892, outstanding liabilities	$144.26	
July 1, 1892, amount covered by uncompleted contracts	1,760.00	
		1,904.26
July 1, 1892, balance available		374.56
Amount appropriated by act approved July 13, 1892		7,236.00
Amount available for fiscal year ending June 30, 1893		7,610.56

COMMERCIAL STATISTICS.

The commerce arriving and leaving Wareham Harbor, Massachusetts, by water during the calendar year ending December 31, 1891, is estimated as follows (based mainly upon reports received from Mr. Alden Besse, Wareham, Mass):

Class of goods.	Exports.	Imports.	Total.	Tonnage.
				Tons.
Tobacco	....	$6,060	$6,060	6
Grain and forage	$109,450	226,465	335,915	14,270
Vegetables and truck	270,000	....	270,000	2,587
Live stock and products	....	41,238	41,238	385
Fish, oysters, etc	30,850	9,013	39,863	10,276
Lumber and products	1,181	51,950	53,131	6,114
Coal, minerals, and products	531,125	580,243	1,111,368	73,374
Machinery and hardware	268,800	78,800	347,600	5,826
General merchandise	45,000	231,960	276,960	1,940
Sundries	....	35,795	35,795	360
Total	1,256,406	1,261,524	2,517,930	115,138

Gain over last year, 12,313 tons.

Transportation lines established during the year, none reported.

The entrances of vessels to this waterway are estimated as follows:

Vessels.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steamers	40	....	....
Barges	20	12½	250
Schooners	190	12½	250
Sailboats	200	....	....

C 6.

IMPROVEMENT OF NEW BEDFORD HARBOR, MASSACHUSETTS.

New Bedford Harbor is an estuary of Buzzard Bay and is the port of the cities of New Bedford and Fairhaven, Mass. New Bedford is an important port of entry. It is largely interested in manufactures, those of cotton predominating, and has an extensive commerce in addition to its whale fisheries. The population of New Bedford and Fairhaven in 1888 was about 38,000.

The object of the improvement is to provide a channel 18 feet deep at mean low water.

The mean rise and fall of the tide is about 3 feet.

ORIGINAL CONDITION.

Before improvement the channel had a ruling depth of about 12½ feet at mean low water.

As early as 1839 some little dredging was done for the improvement of the harbor. The increase of depth obtained, however, was only 2 feet, and the cut but 30 feet wide. A survey of the harbor was made in 1852, but a definite project for its improvement was not made until 1874. The project provided for a channel 200 feet wide and 15 feet deep at mean low water from the deep water just above Palmer Island to the wharves at New Bedford. This project was modified in 1877, increasing the width of channel to 300 feet, and by means of appropriations made in 1875–'76, amounting to $20,000, the project was completed in 1877. Since that time vessels of larger draft have been employed in the harbor, and vessels of 15 feet draft not only now touch the bottom in this channel, but in the channel below Palmer Island, which was not included in the former improvement. There is not sufficient water for the commerce of the port.

PLAN OF IMPROVEMENT.

The present approved project of 1887 provides for the excavation of a channel 200 feet wide and 18 feet deep at mean low water, extending from Butler Flat to the vicinity of the wharves of New Bedford, at a total cost, as estimated in 1887, of $35,000 (see page 514 Annual Report of 1888). A plat of the proposed improvement was published in House Ex. Doc. No. 86, Fiftieth Congress, first session.

APPROPRIATIONS.

Upon the present project appropriations have been made as follows: In 1888, $10,000; 1890, $10,000. Total up to June 30, 1891, $20,000.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1891.

The total amount expended on the present project (including $0.00 outstanding liabilities) up to June 30, 1891, was $12,968.33. The result was the excavation of the western half of the 18-foot channel from the 11-foot bank to the deep water above Palmer Island, and thence the southern half of the channel to the vicinity of the wharves at New Bedford. The resulting increase in commerce renders a large anchorage area necessary for the accommodation of the large vessels which can now enter safely.

OPERATIONS DURING THE LAST FISCAL YEAR.

Value of United States plant, $3,900. Including $213.79 outstanding liabilities, the expenses of the year were $6,782.60.

At the beginning of the fiscal year no work was in progress.

On November 1 the dredge *Texas* and three scows and the tug *Sargon*, all belonging to the Government, were transferred from Pawtucket River to New Bedford, and commenced dredging November 5 in the northern half of the channel leading from the deep water above Palmers Island to the vicinity of the wharves in New Bedford. On December 1 the dredging was discontinued and the plant laid up for the winter. Twenty-eight thousand seven hundred and twenty cubic yards of mud were dredged from the channel, increasing it in width from 100 feet to 166 feet for a distance of 1,000 feet, and to 133 feet for a further distance of 1,060 feet.

The Government plant was considerably increased and improved.

This work was in the local charge of Mr. C. O. Abell as superintendent.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the excavation of the remaining half of the channel 200 feet wide and 18 feet deep, extending from the 11-foot bank to the vicinity of the wharves at New Bedford, and the removal of a few shoal spots between the 11-foot bank and Butler Flats, the southern end of the projected channel.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1893.

It is proposed to apply the balance on hand and the funds asked for to continuing the work of dredging in the new channel.

New Bedford Harbor is in the New Bedford collection district, which is a port of entry. The amount of revenue collected in the last calendar year was $80,531.48.

The nearest light-houses are Clark Point Light and the lights in New Bedford Harbor. The nearest fortification is the fort at Clark Point, Mass.

Money statement.

July 1, 1891, balance unexpended	$7,031.67
June 30, 1892, amount expended during fiscal year	6,568.81
July 1, 1892, balance unexpended	462.86
July 1, 1892, outstanding liabilities	213.79
July 1, 1892, balance available	249.07
Amount appropriated by act approved July 13, 1892	7,500.00
Amount available for fiscal year ending June 30, 1893	7,749.07
Amount (estimated) required for completion of existing project	7,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	7,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

The commerce arriving and leaving New Bedford Harbor, Massachusetts, by water during the calendar year ending December 31, 1891, is estimated as follows (based mainly upon reports received from Mr. James Taylor, collector of customs, New Bedford, Mass.):

Class of goods.	Exports.	Imports.	Total.	Tonnage.
				Tons.
Cotton and products	$459	....	$459	15
Tobacco	1,707	....	1,707	2
Grain and forage	920	$106,000	106,920	4,690
Live stock and products	4,928	....	4,928	39
Naval stores	41	....	41	4
Lumber and products	12,401	....	12,401	824
Coal, minerals, and products	24	2,150,000	2,150,024	467,635
General merchandise	43,751	1,412,000	1,455,751	15,252
Sundries	1,497	....	1,497	62
Total	65,782	3,668,000	3,733,782	488,523

Gain over last year, none known. Transportation lines established during the year, none reported. The entrances and departures of vessels from this waterway are estimated as follows:

Vessels.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight and passenger	1032	8	564
Freight mainly	730	17	822
Passenger mainly	750	8	55
Tugs	984	8	51
Pleasure boats	400	....	....
Sail:			
Freight	2554	13	800
Fishing boats	800	5	10
Pleasure, large	800	....	....
Pleasure, small	2000	....	....

C 7.

IMPROVEMENT OF WESTPORT HARBOR, MASSACHUSETTS.

Westport Harbor is an estuary on the coast of Massachusetts, lying between Narragansett Bay, Rhode Island, and Buzzard Bay, Massachusetts. The site of the work is on Horse Neck Point (the north side of the entrance to the harbor).

ORIGINAL CONDITION.

Before the commencement of the improvement the site of the present work was a point of sand forming the northern and eastern boundary of the entrance to the harbor and subject to erosion by the sea and tides.

In 1886 $1,000 was appropriated for the special protection of Horse Neck Point, on the north side of the harbor entrance. This work was completed in 1887 by the construction of a timber jetty filled with stone.

PLAN OF IMPROVEMENT.

The present approved project of 1888 provides for the construction of jetties at the end of Horse Neck Point, to stop the wearing of this point, and provides also for a small amount of dredging in Westport Harbor, at a total cost, as estimated in 1888, of $2,000. (See p. 646 of Annual Report of 1889.)

APPROPRIATIONS.

Upon the present projects appropriations have been made as follows: In 1890, $1,000; total up to June 30, 1891, $1,000.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1891.

The total amount expended on the present project (including $0.00 outstanding liabilities up to June 30, 1891, was $22.96, which was used in preparations for active field work.

OPERATIONS DURING THE LAST FISCAL YEAR.

Value of United States plant, $0.00. Including $0.00, outstanding liabilities, the expenses of the year were $639.23.

At the beginning of the last fiscal year no work was in progress. Work was commenced on September 10, and continued until October 9. The jetty on Horse Neck, which had been originally built of a timber crib filled with stone, and which had been partially destroyed by a storm, was rebuilt chiefly of stone and brush, utilizing a portion of the old crib.

Two hundred and thirty tons of stone from Masons Island quarry were put in the jetty, making it about 150 feet long.

This work was in the local charge of Mr. A. R. Elliot, as superintendent.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the extension of the present jetty and the dredging on the Lion Tongue Shoal.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1893.

It is proposed to apply the balance on hand to the completion of the project above described.

Westport Harbor is in the collection district of New Bedford, which is a port of entry. The amount of revenue collected at New Bedford during the last calendar year was $30,531.43. The nearest light-house is Seaconnet Light. The nearest fortification is fort at Clark Point, New Bedford, Mass.

Money statement.

July 1, 1891, balance unexpended	$977.04
June 30, 1892, amount expended during fiscal year	639.23
July 1, 1892, balance unexpended	337.81
Amount appropriated by act approved July 13, 1892	1,000.00
Amount available for fiscal year ending June 30, 1893	1,337.81

COMMERCIAL STATISTICS.

The commerce arriving and leaving Westport Harbor, Massachusetts, by water during the calender year ending December 31, 1891, is estimated as follows (based mainly upon reports received from Mr. Abraham Manchester, Adamsville, R. I.):

Class of goods.	Exports.	Imports.	Totals.	Tonnage.
				Tons.
Grain and forage		$13,000	$13,000	553
Vegetables and truck	$4,550		4,550	198
Live stock and products	65,000		65,000	305
Fish, oysters, etc	500		500	8
Lumber and products		1,000	1,000	49
Coal, minerals, and products		2,750	2,750	500
Fertilizers		7,500	7,500	200
Machinery and hardware		6,000	6,000	10
General merchandise		65,880	65,880	469
Sundries		112	112	14
Total	70,050	96,242	166,292	2,306

Gain over last year, none known.

Transportation lines established during the year, none reported.

The vessels using this waterway are reported as follows:

Sail—

Freight	5
Fishing boats	6
Pleasure, large	7
Pleasure boats, small	12

C 8.

IMPROVEMENT OF TAUNTON RIVER, MASSACHUSETTS.

This river rises in Norfolk County, Mass., and empties into Mount Hope Bay, a name given to the northeastern part of Narragansett Bay. It is about 44 miles in length, measured along its course.

The object of the improvement is to deepen and widen the channel leading to the city of Taunton, at the head of navigation, which requires large quantities of coal, iron, clay, moldings, sand, and other heavy articles for its extensive manufactures dependent largely on water transportation, so that vessels of 11-foot draft can reach the city at high water. The rise and fall of the tide before improvement was 5¼ feet at Dighton and 3.4 feet at Taunton.

ORIGINAL CONDITION.

In its original condition the channel was narrow and obstructed by bowlders, and from Berkley Bridge to Taunton the depth was not, in places, more than 5 feet at mean high water. A vessel of 30 tons burden was as large as could go up to Taunton.

From 1870 to 1879 $63,000 was appropriated to secure a depth of 9 feet at high water, up to the head of navigation. This work was completed in 1879 (see page 375 Annual Report of 1880).

PLAN OF IMPROVEMENT.

The present approved project of 1880, as modified in 1888, provides as follows, at a total cost, as estimated in 1888, of $108,000: A channel 60 feet wide and 11 feet deep from Weir Bridge to the shipyard; a channel 80 feet wide (100 feet at the bends) and 11 feet deep from the shipyard down to and through the Needles and Briggs Shoal; thence to Berkley Bridge a channel of the same width and 12 feet deep. From Berkley Bridge to the deep water at Dighton the channel was to be 100 feet wide and 12 feet deep. The depths are estimated from high water. The ledge which crossed the bottom of the river at Peter Point and the numerous bowlders which lay on the bottom and sides of the channel from Taunton to Dighton were to be removed (see pages 373 Annual Report of 1880 and 519 of 1888).

A plat of the river showing the improved channel was published in the Annual Report of the Chief of Engineers for 1884, page 606.

APPROPRIATIONS.

Upon the present project appropriations have been made as follows: 1880, $17,500; 1881, $25,000; 1882, $25,000; 1884, $26,500; 1890, $7,000. Total up to June 30, 1891, $101,000.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1891.

The total amount expended on the present project (including $1,597.19 outstanding liabilities) up to June 30, 1891, was $98,251.50.

With the exception that but 40 feet of the 60 feet of width could be dredged between the bridge at Weir and the ship-yard on account of interfering with private property, and that on account of the hardness and depth of material at the sides the 80-foot channel was not in all cases dredged to its full width, the channel down to Berkley Bridge had been completed. The channel as proposed between Berkley Bridge and Dighton had been completed, with the exception of removing a small amount of ledge rock uncovered in dredging, and had been cleared of bowlders from Taunton down to Berkley Bridge. The work of removal of the ledge at Peter Point had been completed. The material blasted in the channel had been dredged and deposited in the form of a half-tide dam running from Reuben Island to the west shore of the river, with the view of accelerating the current in the dredged channel off and above Dighton and preventing deposits in that part of the channel. Vessels of 11-foot draft can now reach Taunton at the head of navigation.

OPERATIONS DURING THE LAST FISCAL YEAR.

Value of United States plant, $1,300. Including $4.30 outstanding liabilities, the expenses of the year were $2,729.78.

At the beginning of the last fiscal year work was in progress between Pioneer Rock and the Needles and was continued until July 31, when the plant was transferred to other work.

Two thousand six hundred and fifty cubic yards of sand, clay, and bowlders were removed by the dredge *Rhode Island*, assisted by two scows belonging to the Government and a hired tug. The second reach and a portion of the third were completed.

This work was in local charge of Mr. Perry Lawton, as superintendent.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

There remain to complete the existing project the widening and deepening of the channel at a few points above the bridge and the removal of the small amount of ledge rock above referred to. This ledge projects about 30 feet into the eastern side of the channel, diminishing its depth by a few inches, while there is ample width and depth beyond the channel line on the western side.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1893.

It is proposed to apply the balance on hand to the completion of the existing project for the improvement of the river.

Taunton River is in the Fall River collection district. Fall River is the nearest port of entry. The amount of revenue collected at Fall River in the last calendar year was $67,429. The nearest light-house is the Borden Flat light-house. The nearest fortification is Fort Adams, Newport Harbor, Rhode Island.

Money statement.

July 1, 1891, balance unexpended	$4,345.69
June 30, 1892, amount expended during fiscal year	4,322.67
July 1, 1892, balance unexpended	23.02
July 1, 1892, outstanding liabilities	4.30
July 1, 1892, balance available	18.72
Amount appropriated by act approved July 13, 1892	7,000.00
Amount available for fiscal year ending June 30, 1893	7,018.72

COMMERCIAL STATISTICS.

The commerce arriving and leaving Taunton, Mass., by water, during the calendar year ending December 31, 1891, is estimated as follows (based mainly upon reports received from Mr. J. S. Burns, Taunton, Mass.):

Class of goods.	Exports.	Imports.	Totals.	Tonnage.
				Tons.
Cotton and products		$1,750,000	$1,750,000	8,750
Grain and forage		1,070,000	1,070,000	47,300
Lumber and products	$75,000	325,000	400,000	20,400
Coal, minerals, and products	200,000	1,760,000	1,960,000	385,000
General merchandise		920,000	920,000	9,200
Totals	275,000	5,825,000	6,100,000	470,650

Gain over last year, none known.

Transportation lines established during the year, not reported.

No one was found able and willing to furnish any reliable information as to the total vessels entering and leaving this waterway.

C 9.

IMPROVEMENT OF PAWTUCKET RIVER, RHODE ISLAND.

The navigable part of the Pawtucket (or Seekonk) River, an arm of Providence River, extends from Providence to Pawtucket, a city which in 1885 had a population of about 23,000 and extensive manufactures, depending largely on water transportation. The mean rise and fall of the tide is about 5 feet.

ORIGINAL CONDITION.

Before improvement the channel in the river was narrow and had a ruling depth of about 5 feet at mean low water.

Between 1867 and 1882 $52,000 was appropriated to dredge the channel to 75 feet width and 7 feet depth at low water. This work was completed in 1876.

PLAN OF IMPROVEMENT.

The present approved project of 1883 provides for the excavation by dredging of a channel 100 feet wide and 12 feet deep at mean low water from the deep water above Red Bridge to the ledge opposite Grant & Co.'s Wharf at Pawtucket; thence the deepening by blasting of the channel through the ledge to Pawtucket Bridge to the same depth and 40 feet wide, at a total cost, as estimated in 1883, of $382,500. (See page 614 of Annual Report of 1884.)

A plat of the river showing the lines of the proposed channel was published in the Annual Report of the Chief of Engineers for 1884, page 608.

APPROPRIATIONS.

Upon the present project appropriations have been made as follows:

1884	$50,000
1886	30,000
1888	35,000
1890	30,000
Total up to June 30, 1891	145,000

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1891.

The total amount expended on the present project (including $307.48 outstanding liabilities) up to June 30, 1891, was 126,759.50. The new channel, 12 feet deep and 100 feet wide, with wide enlargements at the bends, has been carried from its mouth at the deep water just above Red Bridge a distance of about 12,740 feet, and with a width of 60 feet and of the same depth for an additional distance of about 2,000 feet. There is now a channel 100 feet wide and 12 feet deep at mean low water from the deep water above Red Bridge to Bass Rock, or to within about 1¼ miles of the head of navigation, and a channel 60 feet wide and of the same depth from Bass Rock to a line about 200 feet above Dunnell's Wharf.

About nine-tenths of the work had been done.

This completed portion of the channel is already a great benefit to the commerce of the river. A ruling depth of about 6 feet can be carried from the upper end of our present work to Pawtucket.

OPERATIONS DURING THE LAST FISCAL YEAR.

Value of United States plant, $18,000. Including $482.20 of outstanding liabilities, the expenses of the year were $18,017.82.

At the beginning of the last fiscal year no work was in progress.

On August 8, the United States dredge *Rhode Island* and two scows, and on August 10 the United States dredge *Texas* and three scows, commenced work of dredging. The United States tug *Sargon* and launch *General Warren* and a sand pump belonging to the Government were also engaged upon the work, these being assisted at intervals by hired tugs. The dredge *Texas* was transferred to other work on October 30 and the *Rhode Island* on October 31. About 400 tons of stone were deposited in the form of a wall on the flats opposite Bass Rock to prevent the dredged material deposited behind it from washing back into the channel. The sand pump was utilized for pumping a portion of the dredged material behind this wall and the balance was towed to the dumping ground 23 miles distant.

Seventy thousand two hundred and thirteen cubic yards of sand, gravel, and bowlders were thus dredged from the channel. A channel has now been dredged 12 feet deep at mean low water from the deep water near Red Bridge at the lower end of the work to Grant & Co.'s Wharf in Pawtucket. It is 100 feet wide from its lower end to Bass Rock, 60 feet wide from Bass Rock to Dunnell's Wharf and 100 feet wide from Dunnell's Wharf to the Gas Company's Wharf and thence 40 feet wide to Grant & Co.'s Wharf.

The Government plant was much increased and improved.

This work was in the local charge of Mr. C. O. Abell, as superintendent.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work yet to be done is to excavate the channel to its full width of 100 feet from Bass Rock to Dunnell's Wharf, and from the Gas Company's Wharf to Grant & Co.'s Wharf and to deepen the channel through the ledge to the same depth with a width of 40 feet.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1893.

It is proposed to apply the balance of the funds on hand and the appropriation asked for to extending the channel toward Pawtucket by dredging, and to commencing work on the ledge.

Pawtucket is in the collection district of Providence, and that port is the nearest port of entry. The amount of revenue collected at Providence in the last calendar year was $352,374.05. The nearest light-house is Sassafras Point Light. The nearest fortifications are Fort Adams, Newport, R. I., and the fort on Dutch Island, Rhode Island.

Money statement.

July 1, 1891, balance unexpended	$18,547.98
June 30, 1892, amount expended during fiscal year	17,843.10
July 1, 1892, balance unexpended	704.88
July 1, 1892, outstanding liabilities	482.20
July 1, 1892, balance available	222.68
Amount appropriated by act approved July 13, 1892	35,000.00
Amount available for fiscal year ending June 30, 1893	35,222.68
Amount (estimated) required for completion of existing project	202,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

The commerce arriving and leaving Pawtucket, R. I., by water during the calendar year ending December 31, 1891, is estimated as follows (based mainly upon reports received from Mr. George E. Newell, Pawtucket, R. I.):

Class of goods.	Exports.	Imports.	Totals.	Tonnage.
				Tons.
Cotton and products	$125,000	....	$125,000	625
Lumber and products	185,000	....	185,000	9,365
Coal, minerals, and products	70,000	$847,000	917,000	174,860
Fertilizers	22,500	37,500	60,000	1,600
Total	402,500	884,500	1,287,000	186,450

Gain over last year: None.

Transportation lines established during the year: None reported.

The entrances and departures of vessels from this waterway are estimated as follows:

Steam, freight, and passenger	540
Tugs	540
Barges (coal)	520

C 10.

IMPROVEMENT OF PROVIDENCE RIVER AND NARRAGANSETT BAY, RHODE ISLAND.

Providence River is an estuary of Narragansett Bay. The object of its improvement is to furnish a wide and deep channel for European and coastwise commerce from the ocean to Providence, a city which had in 1885 about 125,000 inhabitants, largely engaged in manufactures, and a port of entry for an extensive region of country, with which it is connected by railroads. The mean rise and fall of the tide is 4.7 feet.

ORIGINAL CONDITION.

Before the improvement of the river was commenced, in 1853, many shoals obstructed navigation, and at one point in the channel, a place called The Crook, the available low-water depth was but 4½ feet.

Between 1852 and 1873 $56,500 was appropriated to secure depths of first 9 and then 12 feet at low water. This work was finished in 1873.

PLAN OF IMPROVEMENT.

The present approved project of 1878, as modified in 1882, provides for a channel 25 feet deep and 300 feet wide, suitable for large ocean vessels, extending from Fox Point, in the city of Providence, to the deep water of Narragansett Bay, and for an anchorage basin between Fox and Fields Points of the following dimensions in cross sections, viz:

300 feet wide, 25 feet deep.
600 feet wide, 20 feet deep.
725 feet wide, 18 feet deep.
940 feet wide, 12 feet deep.
1,060 feet wide, 6 feet deep.

At a total cost, as estimated in 1882, of $675,000. (See page 235 of Annual Report for 1878 and page 556 of 1882.)

The 25-foot channel has been laid out in straight reaches (with enlargements at the angles) with a view to lighten them by range or leading lights, such as are used in similar cases in Chesapeake Bay, Delaware River, and other localities, if it should be found necessary.

A plat of Providence River, showing the improved channel, was published in the Annual Report of the Chief of Engineers for 1884, page 622.

APPROPRIATIONS.

Upon the present project appropriations have been made as follows:

1878	$50,000
1879	60,000
1880	60,000
1881	60,000
1882	125,000
1884	85,000
1886	30,000
1888	40,000
1890	50,000
Total up to June 30, 1891	560,000

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1891.

The total amount expended on the present project (including $21,139.17 outstanding liabilities) up to June 30, 1891, was $554,930. At that date the 25-foot channel 300 feet wide had been completed.

In the Fox Point Reach the anchorage basin on the west side and the 20 and 18 foot areas on the east side had been completed.

In the Sassafras Point Reach, about three-fourths of the 20-foot and one-third of the 18-foot anchorage areas; and in the Fields Point reach, about one-half of the 20-foot anchorage area had been completed.

About five-sixths of all needed work had been done.

OPERATIONS DURING THE LAST FISCAL YEAR.

Value of United States plant, $29,000. Including $29.95 outstanding liabilities, the expenses of the year were $5,020.45.

At the beginning of the last fiscal year the work of dredging was in progress under the contract with Charles & Henry E. Dubois, of New York, N. Y., dated April 20, 1891, and was continued until August 10, when the contract was completed.

Eighty-seven thousand seven hundred and seventy-six cubic yards of mud were thus removed, completing the 12 and 6 foot anchorage areas on the east side of Fox Point Reach, and the 20-foot and part of the 18-foot areas in the Sassafras Point Reach.

The Government dredging plant was much increased and improved.

This work was under the local charge of Mr. W. C. Simmons, as inspector.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

There is required for the completion of the existing project the remainder of the excavation of the anchorage basin between the head of Sassafras Point Reach and Field Point.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1893.

It is proposed to apply the balance of the funds on hand and the appropriation asked for to continuing the excavation of the anchorage area.

Providence River is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence in the last calendar year was $352,374.05. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are fort on Dutch Island and Fort Adams, R. I.

Money statement.

July 1, 1891, balance unexpended	$26,209.17
June 30, 1892, amount expended during fiscal year	26,129.67
July 1, 1892, balance unexpended	79.50
July 1, 1892, outstanding liabilities	29.95
July 1, 1892, balance available	49.55
Amount appropriated by act approved July 13, 1892	50,000.00
Amount available for fiscal year ending June 30, 1893	50,049.55
Amount (estimated) required for completion of existing project	65,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	65,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

The commerce arriving at Providence, R. I., by water during the calendar year ending December 31, 1891, is estimated as follows (based mainly upon reports received from Mr. F. P. Little, secretary Board of Trade, Providence, R. I.):

Class of goods.	Imports.	Tonnage.
		Tons.
Lumber and products	$222,450	31,240
Coal, minerals, and products	3,464	866
Machinery and hardware	90	½
General merchandise	13,687,218	1,318,232
Total	13,913,222	1,350,338½

Gain over last year, none known.

Transportation lines established during the year, none reported.

The above are the receipts by water from foreign countries only. The domestic imports and exports by water could not be obtained.

The vessels using this waterway are reported as follows:

	No.	Average tonnage.
		Tons.
Steam, freight and passengers	38	559
Sail, freight mainly	77	127

The vessels arriving at this port from foreign countries are reported as follows: Steam and sail, 110.

C 11.

REMOVAL OF GREEN JACKET SHOAL, PROVIDENCE RIVER, RHODE ISLAND.

Green Jacket Shoal is in that part of Providence River which constitutes the harbor of Providence.

It lies off the wharves on the south front of the city and occupies a part of the harbor that is required for anchorage purposes.

ORIGINAL CONDITION.

That part of the harbor in which the shoal is located is about 2,000 feet long by from 600 to 1,200 feet wide; and of this area the shoal occupied about 30 acres, and that part of it which was included between the 15-foot curves occupied about 18 acres. There were channels on either side of the shoal, between it and the harbor lines, having, the one on the north side, a width of 300 feet and a depth of 20 feet, and the one on the south side, a width varying from 50 to 100 feet and a depth of about 15 feet at mean low water. The water on the summit of the shoal was 1 foot deep.

PLAN OF IMPROVEMENT.

The present approved project, of 1885, provides for the removal of the entire shoal to a depth of 25 feet at mean low water, limiting the work by lines drawn 200 feet from the harbor lines, at a total cost, as estimated in 1885, of $112,346 (see page 602 of Annual Report of 1885).

A plat of Green Jacket Shoal was published in the Annual Report of the Chief of Engineers for 1885, Part I, page 599.

APPROPRIATIONS.

Upon the present project appropriations have been made as follows:

1886	$26,250
1888	28,000
1890	25,000
Total up to June 30, 1891	79,250

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1891.

The total amount expended on the present project (including $332.44, outstanding liabilities) up to June 30, 1891, was $65,329.

The result was the excavation to a depth of 25 feet at mean low water of an area of about 13¾ acres, extending along the northern and western sides of the shoal, making an important addition to the anchorage facilities of the harbor. On a portion of this area the depth of water before the completion of the contract of November 18, 1886, was from 3 to 4 feet.

OPERATIONS DURING THE LAST FISCAL YEAR.

Value of United States plant, $9,500, including $5.90 of outstanding liabilities; the expenses of the year were $13,908.82.

At the beginning of the last fiscal year no work was in progress.

On August 12, the work of dredging was commenced under the contract with Charles and Henry E. Du Bois, of New York, N. Y., dated April 20, 1891, and continued until October 27, when their contract was completed.

One hundred and twenty-five thousand one hundred and four cubic yards of mud and shells were thus dredged, increasing the dredged area by about 4.4 acres.

The Government dredging plant was somewhat increased and improved.

This work was under the local charge of Mr. W. C. Simmons as superintendent.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the excavation of the eastern end of the shoal to a depth of 25 feet.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1893.

It is proposed to apply the balance on hand and the funds asked for to continuing the removal of the shoal according to the general project.

Green Jacket Shoal is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence during the last calendar year was $352,374.05. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are Fort Adams, R. I., and the fort on Dutch Island, Rhode Island.

For the commercial statistics, see "Report of the improvement of Providence River and Narragansett Bay, Rhode Island."

Money statement.

July 1, 1891, balance unexpended	$14,253.44
June 30, 1892, amount expended during fiscal year	14,235.36
July 1, 1892, balance unexpended	18.08
July 1, 1892, outstanding liabilities	5.90
July 1, 1892, balance available	12.18
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	10,012.18
Amount (estimated) required for completion of existing project	23,096.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	23,096.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

C 12.

IMPROVEMENT OF GREENWICH BAY, RHODE ISLAND.

Greenwich Bay is an arm of Narragansett Bay, located in the towns of Warwick and East Greenwich, R. I. It has a length from northwest to southeast of about 3½ miles and an average width of 1½ miles.

ORIGINAL CONDITION.

The channel leading to the town of East Greenwich was deep enough for the demands of commerce, but so crooked as to render navigation difficult.

PLAN OF IMPROVEMENT.

The present approved project of 1888 provides for the straightening and widening of the channel by the removal of sand bars, called Long Point, at a total cost, as estimated in 1888, of $2,000. (See page 650 of Annual Report of 1889.)

APPROPRIATIONS.

Upon the present project appropriations have been made as follows: 1890, $2,000. Total up to June 30, 1891, $2,000.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1891.

The total amount expended on the present project (including $92.92 outstanding liabilities) up to June 30, 1891, was $1,989, with which about 210 feet length of the point of the shoal at Long Point was cut off, and the channel was somewhat widened over a length of about 500 feet.

OPERATIONS DURING THE LAST FISCAL YEAR.

Value of United States plant, $0.00. Including $0.00 outstanding liabilities the expenses of the year were $11.00; work being confined to payments of outstanding liabilities and to minor office duties.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1893.

The project being completed, no work is anticipated for the coming year.

Greenwich Bay is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence during the last calendar year was $352,374.05. The nearest fortification is the fort on Dutch Island, Rhode Island. The nearest light-house is Warwick Light.

Money Statement.

July 1, 1891, balance unexpended	$103.92
June 30, 1892, amount expended during fiscal year	103.60
July 1, 1892, balance unexpended	.32
July 1, 1892, outstanding liabilities	.32

COMMERCIAL STATISTICS.

The commerce arriving at East Greenwich, R. I., by water, during the calendar year ending December 31, 1891, is estimated as follows (based mainly upon reports received from Mr. Joseph Dews, East Greenwich, R. I.):

Class of goods.	Imports.	Tonnage.
		Tons.
Lumber and products	$45,000.00	3,825
Coal, minerals, and products	56,250.00	15,000
Totals	101,250.00	18,825

Gain over last year; none known.

Transportation lines established during the year; none reported.

The vessels using this waterway are reported as follows: Sail (freight), 2; average draft, 12 feet; average tonnage, 400 tons; fishing boats, 18.

C 13.

IMPROVEMENT OF COVE AND WATERWAY NEAR COASTER HARBOR ISLAND, RHODE ISLAND.

This cove is situated in the northwestern part of the city of Newport, R. I., near the southeastern extremity of Coaster Harbor Island, which is occupied by the U. S. Navy as a training station.

ORIGINAL CONDITION.

A causeway connecting Coaster Harbor Island with Rhode Island forms the northern boundary of the cove and separates it from the waterway above. This causeway, having but one small opening, has checked the flow of water around the island and caused deposits, so filling the waterway as to cause it to give forth unhealthy and disagreeable odors.

PLAN OF IMPROVEMENT.

The present approved project of 1889 proposes to dredge the cove to the necessary depth and to increase the flow of water by larger openings in the causeway, so that the garbage and waste thrown into the water will be carried away by the current, at a total cost, as estimated in 1889, of $5,500. (See page 591 of Annual Report of 1890.)

A plat of this cove was published in House Ex. Doc. No. 65, Fifty-first Congress, first session.

APPROPRIATIONS.

Upon the present project, appropriations have been made as follows: 1890, $5,500; total up to June 30, 1891, $5,500.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1891.

Total amount expended on the present project (including $138.03 outstanding liabilities) up to June 30, 1891, was $2,405, with which the cove was dredged in places where specially needed and four bridge trusses of 30 feet span each were prepared for use over openings to be cut in the causeway.

OPERATIONS DURING THE LAST FISCAL YEAR.

Value of United States plant, $0.00. Including $186.65 of outstanding liabilities the expenses of the year were $1,282.56.

At the beginning of the last fiscal year no work was in progress. On June 17, 1892, the work of cutting through the causeway and erecting bridges was commenced, but on the 20th June, in order that communication by land with the island of Rhode Island should not be cut off until after the completion of certain contracts of the Navy Department, work was stopped, to be resumed in July or August.

The bridges are framed and ready to put in position.

This work was under the local charge of Mr. E. Parrish, as assistant engineer.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

To complete the existing project it is only necessary to cut the causeway, finish the abutments, and erect the bridges.

Coaster Harbor Island is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last calendar year was $881.19. The nearest light-house is Gull Rock Light. The nearest fortification is Fort Adams, Newport, R. I.

Money statement.

July 1, 1891, balance unexpended	$3,233.03
June 30, 1892, amount expended during fiscal year	1,233.94
July 1, 1892, balance unexpended	1,999.09
July 1, 1792, outstanding liabilities	186.65
July 1, 1892, balance available	1,812.44

C 14.

IMPROVEMENT OF NEWPORT HARBOR, RHODE ISLAND.

This harbor is at the main entrance to Narragansett Bay. These waters during the summer and winter constitute a harbor of refuge for our European and coastwise commerce quite equal in every respect to that of New York Harbor, and are even more accessible. The objects of the improvement are to widen and deepen the southern (the main) entrance to the harbor, and to enlarge its capacity for vessels seeking refuge in storms by increasing the area and depth of the anchorage within it. The mean rise and fall of the tide is about 3¾ feet.

ORIGINAL CONDITION.

Before improvement the capacity of the inner harbor was limited by shoals, and it was not adequate to the number and size of vessels seeking it for refuge. The southern (the main) entrance was obstructed by a bar which stretched out from Goat Island, and the general business wharves of the city could not be reached at low tide by vessels drawing more than 8 feet.

Between 1873 and 1875, $28,500 was appropriated to dredge a 12-foot channel up to the city wharves and build a small jetty to arrest the flow of sand into the main channel and harbor, and to protect the western face of Goat Island. (See page 29 of Annual Report of 1873.) This work was completed in 1876.

PLAN OF IMPROVEMENT.

The present approved project of 1880, as modified in 1882, 1883, and 1884, provided for work as follows, at a total cost, as estimated in 1884, of $132,000. (See page 562 of Annual Report of 1881, page 561 of 1882, page 603 of 1885.):

Deepening the southern entrance to 15 feet at mean low water and widening it by dredging Goat Island Spit northward to a line drawn from the dolphin which marks the spit to clear the permanent dock at Fort Adams by 100 feet, and by the excavation of a channel 750 feet wide and 15 feet deep at mean low water around and to the eastward of this dolphin; excavating to 13 feet at mean low water the area included between the 13-foot curve on the west, a line drawn from the southwest corner of Perry Mill Wharf to Lime Rock on the south, the harbor line on the east, and a line drawn parallel to and 50 feet from the City Wharf on the north; excavating to 10 feet at mean low water the area northwest of a line drawn from Lime Rock through the spindle, which is in the southeast part of the harbor; the excavation of a channel 10 feet deep at mean low water along and outside the harbor line south to a point opposite the Gas Company's Wharf, and the construction of jetties on the western shore of Goat Island to arrest the drift of littoral sand and gravel into the southern entrance.

A plat of Newport Harbor, showing the plans of the work, was published in the Annual Report of the Chief of Engineers for 1885, Part I, page 604.

APPROPRIATIONS.

Upon the present project appropriations have been made as follows: 1881, $25,000; 1882, $20,000; 1884, $20,000; 1886, $15,000; 1888, $12,000; 1890, 12,500. Total up to June 30, 1891, $104,500.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1891.

The total amount expended on the present project (including $1,295.88 outstanding liabilities) up to June 30, 1891, was $104,480, with the following results:

The area to be dredged to 13 feet within the harbor has been completed. The channel along and outside the harbor line south to a point opposite the Gas Company's Wharf, and the 15-foot channel 750 feet wide around and to the eastward of the dolphin on Goat Island Spit, has also been completed. The berth for vessels at the Quartermaster's Wharf at Fort Adams had been deepened to 10 feet at mean low water, and the littoral sand from the outside of Goat Island had been stopped for the present from washing into the channel at the southern entrance of the harbor by the construction of a jetty on the west side of the island. The southern entrance is completed for vessels of 15 feet draft, and of the total area (about 90 acres) to be dredged within the harbor about 66 acres has been completed.

OPERATIONS DURING THE LAST FISCAL YEAR.

Value of United States plant, $2,800. Including $0.33 of outstanding liabilities, the expenses of the year were $18.13.

No work was done on the above project but rendering of reports and completion of payments for past work.

Based upon the special report submitted December 19, 1890 (see page 736 of Annual Report of 1890), Congress, in its river and harbor act of 1892, extended work under past projects for this harbor so as to include the work of removal of the spit at the south end of Goat Island to a depth of 15 feet, at an estimated cost of $24,200, thus increasing the estimated cost of Newport work to a total of $156,200.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the excavation of the 10-foot anchorage area within the harbor, the removal of Goat Island Spit to 15 feet depth, and the building of additional jetties outside of Goat Island whenever they may be required to arrest the drift of littoral sand and gravel into the harbor entrance.

OPERATIONS CONTEMPLATED DURING THE FISCAL YEAR ENDING JUNE 30, 1893.

It is proposed to apply the funds asked for to the completion of the existing project.

Newport is in the collection district of Newport, and is a port of entry. The amount of revenue collected at Newport in the last calendar year was $881.19. The nearest light-houses are Lime Rock and Newport (Goat Island) lights. The nearest fortification is Fort Adams, Newport, R. I.

Money statement.

July 1, 1891, balance unexpended	$1,315.88
June 30, 1892, amount expended during fiscal year	1,313.68
July 1, 1892, balance unexpended	2.20
July 1, 1892, outstanding liabilities	.33
July 1, 1892, balance available	1.87
Amount appropriated by act approved July 13, 1892	25,000.00
Amount available for fiscal year ending June 30, 1893	25,001.87
Amount (estimated) required for completion of existing project	26,700.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	26,700.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The commerce arriving at Newport Harbor, Rhode Island, by water during the calendar year ending December 31, 1891, is estimated as follows (based mainly upon reports received from Mr. Clarence A. Hammet, deputy collector of customs, Newport, R. I.):

Class of goods.	Imports.	Tonnage.
		Tons.
Lumber and products	$24,475	1,363

Gain over last year, none known; transportation lines established during the year, none known.

The above are the receipts by water from foreign countries only. The domestic imports and exports by water could not be obtained.

The entrances and departures of vessels from this waterway could not be obtained.

C 15.

HARBOR OF REFUGE AT POINT JUDITH, RHODE ISLAND.

Point Judith is the southeastern extremity of South Kingston, R. I., and marks the southwestern entrance to Narragansett Bay.

ORIGINAL CONDITION.

Its shores are covered with bowlders, and a number of wrecks are scattered along the beach on each side of the point. A long ledge, known as Squid Ledge, extends for nearly a mile in a south by easterly direction about 1½ miles west of the point.

PLAN OF IMPROVEMENT.

The present approved project of 1889 proposes to construct a breakwater along the course of Squid Ledge, mentioned above, and between the southern extremity of the ledge and Point Judith, at a total cost, as estimated in 1889, of $1,250,000. (See page 595 of Annual Report of 1890.)

A plat of the locality was published in House Ex. Doc. No. 66, Fifty-first Congress, first session.

APPROPRIATIONS.

Upon the present projects, appropriations have been made as follows: 1890, $75,000. Total up to June 30, 1891, $75,000.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1891.

The total amount expended on the present project (including $6,028.85 outstanding liabilities) up to June 30, 1891, was $30,700, with which a quarry was opened, quarry and floating plant built; about 3,000 tons of stone were placed in position at the outer end of Squid Ledge, and a beacon was established thereon to mark the center of the proposed breakwater. Work was commenced on the outer end of Squid Ledge to be extended one arm to the north, and the other to the east, with a view to securing a sheltered area for the vessels engaged on the work.

OPERATIONS DURING THE LAST FISCAL YEAR.

Value of United States plant, $17,000. Including $1,135.34 outstanding liabilities, the expenses of the year were $43,685.08.

At the beginning of the last fiscal year the work of placing stone in the breakwater near the outer end of Squid Ledge was in progress, and was continued as the weather would permit until November 20.

Eight thousand six hundred and thirty tons of riprap stone were thus placed in the breakwater, raising its center to low-water level, and extending it about 200 feet along both arms. The stone used was quarried at Masons Island, Connecticut, and carried to the work in vessels owned and hired by the Government.

The light on the beacon marking the site of this work has been maintained during the year with the exception of a few days, on which, by reason of ice and the high sea, it was impossible to reach it. A bell buoy has been placed by the Light-House Service a short distance to the south of the work to warn vessels of its proximity in foggy weather.

The Government plant at quarry and afloat was much increased and improved.

This work was under the local charge of Mr. William B. Poland, as supreintendent.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the extension of the breakwater.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1893.

It is proposed to apply the balance on hand and the funds asked for to continuing the construction of the breakwaters.

Point Judith is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last calendar year was $881.19. The nearest light-house is Point Judith Light. The nearest fortification is the fort on Dutch Island. Rhode Island. The population of South Kingston, by the Rhode Island State census of 1885, was 5,549.

Money statement.

July 1, 1891, balance unexpended	$50,328.85
June 30, 1892, amount expended during fiscal year	48,578.59
July 1, 1892, balance unexpended	1,750.26
July 1, 1892, outstanding liabilities	1,135.34
July 1, 1892, balance available	614.92
Amount appropriated by act approved July 13, 1892	75,000.00
Amount available for fiscal year ending June 30, 1893	75,614.92
Amount (estimated) required for completion of existing project	1,100,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	100,000.00
Submitted in compliance with requirement of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

The number of vessels passing Point Judith, Rhode Island, during the calendar year ending December 31, 1891, is estimated as follows, based mainly upon reports received from Mr. Asa Church, keeper Point Judith Life-Saving Station, Rhode Island:

Class.	Number.	Average approximate tonnage.	Total tonnage.
		Gro. tons.	*Gro. tons.*
Steamers (freight and fish)	9,223	500	4,611,500
Yachts (steam and sail)	5,220	100	522,000
Schooners (2, 3, and 4 masts)	26,160	600	15,696,000
Ships, barks, and barkentines	184	900	165,600
Brigs and brigantines	195	300	58,500
Sloops	1,520	20	30,400
Barges	6,683	300	2,004,900
Totals	49,185	....	23,088,900

C 16.

HARBOR OF REFUGE AT BLOCK ISLAND, RHODE ISLAND.

This island is a part of the State of Rhode Island; it is 14 miles east of Montauk Point, the eastern end of Long Island, and its nearest point is about 10 miles from the mainland. Besides the wants of the mackerel-fishing fleet and the general coast navigation the island is an important point on our shores for ocean navigation. It has a signal station connected by submarine telegraph with the mainland. Vessels are passing the island at all times and on all sides of it, and its position renders it of national importance. The object of the improvement is to furnish a harbor of refuge for vessels engaged in foreign and coastwise commerce. The mean rise and fall of the tide is about 3 feet.

ORIGINAL CONDITION.

Before the construction of the present harbor of refuge Block Island had no harbor which afforded protection for decked vessels. The only ones used were open boats, which, on the approach of storms, were hauled up on the beach by oxen. The largest of these boats were of about 10 tons burden.

Between 1870 and 1876 $285,000 was appropriated to build a breakwater, for a harbor of medium-draft vessels. This work, including an inner harbor of 7 feet depth for temporary use of the Government plant, was completed in 1878. (See page 202 of Annual Report of 1877, and page 313 of 1879.)

In 1880, $6,000 was appropriated for dredging the inner basin to 9 feet depth. This work was completed in 1881. (See page 390 of Annual Report of 1880 and page 563 of 1881.)

In 1882, $19,000 was appropriated for building a sea wall on the east side of the inner basin, and protecting the cliffs on east side of breakwater. (See page 563 of Annual Report of 1882.) This work was completed in 1884.

In 1884, $15,000 was appropriated for additions to the old breakwater. (See page 628 of Annual Report of 1884.) This money was spent in 1884–'85 in partially closing a gap in this old breakwater.

PLAN OF IMPROVEMENT.

The present approved project of 1884, as modified in 1888, provides for entirely closing a gap in the old breakwater ($24,000) for constructing an enlarged inner harbor ($46,000), and for special temporary dredging ($5,000) along the east side of the enlarged harbor (see page 609 of Annual Report of 1885, page 613 of 1885, and page 506 of 1886) thus completing at a total cost of $75,000, a harbor of refuge on the eastern side of the island, consisting of an inner harbor or basin for small vessels and an exterior harbor for large ones. The basin was to be about 950 feet square and completely inclosed, with the exception of an opening 100 feet in width. The exterior harbor was to be formed by the old riprap breakwater. A plat of Block Island, showing the position of the harbor of refuge and a plan of the works, may be found in the Report of the Chief of Engineers for 1885, Part I, pages 612, 613.

APPROPRIATIONS.

Upon the present project appropriations have been made as follows: 1886, $20,000; 1888, $15,000; 1890, $15,000. Total up to June 30, 1891, $50,000.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1891.

The total amount expended on the present project (including $4,861.03 outstanding liabilities) up to June 30, 1891, was $45,416. The filling of the gap in the main breakwater had been completed in 1888 (see page 724, Annual Report for 1891). The timber jetty filled with stone, forming the shore end of the western wall of the enlarged inner harbor had been commenced in 1888, the north wall east of the opening into the harbor had been finished in 1889 and about 140 feet of the wall west of the opening built to the level of mean high water. The shoal west of the breakwater had been dredged in 1889 to 9 feet at mean low water from the steamboat wharf to within 100 feet of the north wall.

OPERATIONS DURING THE LAST FISCAL YEAR.

Value of the United States plant, $3,300. Including $91.98 outstanding liabilities, the expenses of the year were $4,562.01.

At the beginning of the last fiscal year the work of constructing the sea walls to enclose the enlarged inner harbor was in progress and was continued until October 17, 1891. Two thousand three hundred and eighty-one tons of stone were placed in the work, making the completed portion of the north sea wall west of the opening into the harbor 130 feet long, raising 35 feet of it to the level of high water and 270 feet to within 1 foot of this level, which carries this portion to its junction with the west sea wall, on which about 90 feet of the foundation was laid. The stone used was quarried at Mason's Island quarry and was transported in vessels owned and hired by the Government.

Lights have been maintained on the north sea wall during the year, excepting the last two weeks in June, when, from want of available funds, they were discontinued.

The work was in the local charge of Mr. F. I. Angell, as superintendent.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the raising and widening of the north and west walls of the enlarged inner harbor.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1893.

It is proposed to apply the balance of the funds on hand and the appropriation asked for to the continuation of the work according to the existing project.

Block Island is in the Newport collection district and Newport is the nearest port of entry. The revenue collected in Newport in the last calendar year was $881.19. There is no duty collected at the island. The value of the harbor is mainly as a harbor of refuge. There are several lights at the island. The nearest fortification is Fort Adams, R. I.

Money statement.

July 1, 1891, balance unexpended	$9,445.03
June 30, 1892, amount expended during fiscal year	9,331.06
July 1, 1892, balance unexpended	113.97
July 1, 1892, outstanding liabilities	91.98
July 1, 1892, balance available	21.99
Amount appropriated by act approved July 13, 1892	24,000.00
Amount available for fiscal year ending June 30, 1893	24,021.99
Amount (estimated) required for completion of existing project	1,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	1,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

The commerce arriving and leaving Block Island Harbor, R. I., by water during the calendar year ending December 31, 1891, is estimated as follows (based mainly upon reports received from Mr. C. C. Ball, Block Island, R. I.):

Class of goods.	Exports.	Imports.	Totals.	Tonnage.
				Tons.
Tobacco		$20,000	$20,000	25
Rice		1,200	1,200	14
Grain and forage	$500	21,412	21,912	612
Vegetables and truck	4,500		4,500	200
Live stock and products	55,440	10,310	65,750	808
Fish, oysters, etc	88,662	1,875	90,537	9,186
Lumber and products		112,500	112,500	5,738
Coal, minerals, and products		67,750	67,750	7,400
Fertilizers		3,000	3,000	100
Machinery and hardware		1,000	1,000	3
General merchandise		341,125	341,125	4,769
Sundries	118,750	2,700	121,450	6,837
Total	267,852	582,872	850,724	35,692

Gain over last year, 6,047 tons.

Transportation lines established during the year, none reported.

The entrances and departures of vessels from this waterway are estimated as follows:

	No.	Average draft.	Average tonnage.
STEAM.		*Feet.*	*Gro. tons.*
Freight and passenger	976	7	589
Fishing	650	7½	125
Tugs	175	7½	125
Pleasure boats	950	7	135
SAIL.			
Freight	350	9	150
Fishing boats	9,000	8	30
Pleasure, large	500	7	12
Pleasure boats, small	75,000	5½	3

C 17.

IMPROVEMENT OF PAWCATUCK RIVER, RHODE ISLAND AND CONNECTICUT.

The navigable part of Pawcatuck River extends from the manufacturing town of Westerly to Little Narragansett Bay, into which it empties. The approach to the river is through Stonington Outer Harbor and Little Narragansett Bay, and the object of the improvement is to deepen and widen the river channel leading from this bay to Westerly.

The mean rise and fall of the tide are 2.60 feet at the mouth of the river and 2.30 feet at Westerly.

ORIGINAL CONDITION.

Before improvement the channel was narrow, crooked, and obstructed by numerous shoals, on some of which there was but 1½ feet at mean low water. (For map, see page 314 of Annual Report of 1879.)

Between 1871 and 1876 $50,000 was appropriated for the excavation of a channel 5½ feet deep at mean low water and 75 feet wide below the wharves, and from 35 to 40 feet wide between the lower and upper wharves. This work was completed in 1876. (See page 211 of Annual Report of 1876.)

PLAN OF IMPROVEMENT.

The present approved project of 1885 contemplates the widening of the channel to 100 feet below the wharves and an additional width of two cuts of an ordinary dredging machine, or about 40 feet, between the lower and the upper wharves; also the deepening of the entire channel to 8 feet at mean low water, at a total cost, as estimated in 1885, of $38,600. (See page 624 of Annual Report of 1885.)

APPROPRIATIONS.

Upon the present project appropriations have been made as follows: 1886, $12,000; 1888, $10,000; 1890, $16,600; total up to June 30, 1891, $38,600.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1891.

The total amount expended on the present project (including $6,949.69 outstanding liabilities) up to June 30, 1891, was $34,715; and the result was the completion to its full width and depth from the deep water opposite the village of Lottery to within about a half mile of the city wharves, and the removal to a depth of 8 feet at mean low water of the ledges at Certain Draw Point and Pawcatuck Rock.

OPERATIONS DURING THE LAST FISCAL YEAR.

Value of the United States plant, $2,500. Including $595.91 outstanding liabilities, the expenses of the year were $3,726.97.

At the beginning of the last fiscal year the work of dredging was in progress under the contract with the Hartford Dredging Company of Hartford, Conn., and was continued until August 29, 1891, when the contract was completed.

On November 5 the work of dredging was resumed with the dredge *Rhode Island*, two scows, and the launch *General Warren* (all belonging to the Government) and was continued until December 18, when the plant was laid up for the winter. It was again resumed on June 7, and discontinued on the 17th to await further appropriations.

Twenty-five thousand four hundred and sixteen cubic yards were excavated during the year, extending the dredged channel with the full width and depth to within one quarter of a mile of the lower wharves of Westerly, with a least width of 60 feet to within one-eighth of a mile, with a least width of 40 feet to the lower wharves themselves, and to about 300 feet above them.

This work was under the local charge of Mr. A. H. Dickens as superintendent.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The ledge rock, to an extent of about 3,400 tons, costing for its removal in 1889 about $3,800, was an item not foreseen and not provided for in the original estimates, and consequently 3,800 more will be needed to complete the entire dredging originally estimated for.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the dredging of the channel to a depth of 8 feet at mean low water and full width of 100 feet over the half mile below Westerly, and a width of 40 feet between the upper and lower wharves of that town.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1893.

It is proposed to complete the work.

Pawcatuck River is in the collection districts of Providence and Stonington, the dividing line passing through the river. Providence and Stonington are the nearest ports of entry. The revenue collected in the last calendar year was Providence $352,374.05; Stonington, $1,215.98. The nearest light-houses are the Stonington and Watch Hill lights. The nearest fortification is Fort Trumbull, New London, Conn.

Money statement.

July 1, 1891, balance unexpended	$10,834.69
June 30, 1892, amount expended during fiscal year	10,080.75
July 1, 1892, balance unexpended	753.94
July 1, 1892, outstanding liabilities	595.91
July 1, 1892, balance available	158.03
Amount appropriated by act approved July 13, 1892	3,800.00
Amount available for fiscal year ending June 30, 1893	3,958.03

COMMERCIAL STATISTICS.

The commerce arriving and leaving Pawcatuck River by water during the calendar year ending December 31, 1891, is estimated as follows) based mainly upon reports received from Messrs. Maxson & Co., Westerly, R. I.):

Class of goods.	Exports.	Imports.	Total.	Tonnage.
Grain and forage	....	$11,308	$11,308	617
Lumber and products	$1,500	99,901	101,401	5,171
Coal, minerals, and products	25,710	161,602	187,312	33,765
Sundries	15,565	....	15,565	1,946
Total	42,775	272,811	315,586	41,499

Gain over last year: None.

Transportation lines established during the year: None reported.

The entrances and departures of vessels from this waterway are estimated as follows:

Steam:	
Passengers, mainly	400
Tugs	600
Sail, freight	285

C 18.

HARBOR OF REFUGE AT STONINGTON, CONNECTICUT.

Stonington Harbor lies on the north side of the eastern entrance from the ocean into Long Island Sound, and the main object of the improvement is to furnish a harbor of refuge for vessels entering and leaving this entrance to the sound. The mean rise and fall of the tide is about 2¾ feet.

ORIGINAL CONDITION.

Originally it was an open bay, unprotected from southerly storms, and obstructed by a shoal, having a low water depth of but 6 feet at the shoalest part. This shoal nearly filled the inner harbor, and left but a narrow channel on either side of a depth insufficient to permit vessels of 12 feet draft to reach the upper wharves at low water.

Between 1827 and 1831, about $37,000 was spent in constructing piers or small breakwaters in the inner harbor for the protection of the harborage. (See page 326, Part I, Annual Report of 1879.)

Between 1871 and 1873, $46,166 was appropriated for a survey of the harbor and for dredging the harbor to 12 feet depth. This work was finished in 1875. (See page 246, Part II, Annual Report of 1874.)

Between 1875 and 1879, $112,500 was appropriated for the construction of a western breakwater, running southeast 2,000 feet from Wampaset Point to 18 feet depth of water, and for dredging to 12 feet depth inside of this breakwater. (See pages 243, 244, 245, Part II, Annual Report of 1875.) This work was completed in 1880.

PLAN OF IMPROVEMENT.

The present approved project of 1880, as modified in 1882, provides the construction of an eastern breakwater to extend from the vicinity of Bartletts Reef to the Middle Ground, at a total cost, as estimated in

1882, of $143,000. (See page 583, Part I, Annual Report of 1880, and page 598, Part I, 1882.)

The position of the western end of the eastern breakwater has not been determined, but it will probably be found necessary, in order to afford all the protection desired, to extend the breakwater at least until it intersects a range from Stonington Light to the middle of Wicopessit Island. It may then be found desirable to carry it still farther, possibly to the range from Stonington Light to the eastern end of Fisher Island.

A plat of this harbor, showing the position of the breakwaters, was published in the Annual Report of the Chief of Engineers for 1882, Part I, page 598, and 1884, Part I, page 632.

APPROPRIATIONS.

Upon the present project appropriations have been made as follows: 1880, $25,000; 1881, $30,000; 1882, $25,000; 1884, $10,000; 1886, $20,000; 1888, $8,000; 1890, $12,500. Total up to June 30, 1891, $130,500.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1891.

The total amount expended on the present project (including $2,710.20 outstanding liabilities) up to June 30, 1891, was $130,010, by which the eastern breakwater was built to a length of about 2,377 feet.

OPERATIONS DURING THE LAST FISCAL YEAR.

Value of United States plant, $1,300. Including $30.46 outstanding liabilities, the expenses of the year were $481.88.

At the beginning of the last fiscal year the work of constructing the eastern breakwater was in progress. This work was discontinued on September 1, after 447 tons of stone had been put in the work to strengthen the end of the work as left earlier in the season.

The stone used was from Masons Island quarry and was transported to the work in vessels hired by the Government.

This work was in the local charge of Mr. F. I. Angell as superintendent.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is to finish the construction of the eastern breakwater. In case it be found that sufficient protection to the harbor of refuge has been afforded when the range from Stonington Light to the middle of Wicopessit Island is reached, the length of the breakwater yet to be built is about 193 feet. Should it be decided to extend it to the middle ground it will require about 100 feet more.

The completion of this work will afford a thoroughly protected anchorage for vessels drawing 18 feet of water and a harbor of refuge for the commerce which daily passes between Long Island Sound and the eastward.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1893.

If an appropriation is made it is proposed to extend the eastern breakwater farther to the westward.

Stonington Harbor is in the Stonington collection district and is a port of entry. The amount of revenue collected at Stonington in the last calendar year was $1,215.98.

The principal value of the harbor is as a harbor of refuge. The nearest lights are Stonington Light and Latimer Reef Light. The nearest fortification is Fort Trumbull, New London Harbor, Connecticut.

Money statement.

July 1, 1891, balance unexpended	$3,200.20
June 30, 1892, amount expended during fiscal year	3,161.62
July 1, 1892, balance unexpended	38.58
July 1, 1892, outstanding liabilities	30.46
July 1, 1892, balance available	8.12
Amount appropriated by act approved July 13, 1892	12,500.00
Amount available for fiscal year ending June 30, 1893	12,508.12

COMMERCIAL STATISTICS.

The commerce arriving and leaving Stonington Harbor, Connecticut, by water during the calendar year ending December 31, 1891, is estimated as follows (based mainly upon the reports received from Mr. Charles T. Stanton, collector of customs, Stonington, Conn., and Mr. Richard Deming, Providence and Stonington Steamship Company, New York, N. Y.):

Class of goods.	Exports.	Imports.	Totals.	Tonnage.
				Tons.
Grain and forage	....	$11,000	$11,000	600
Lumber and products	....	125,000	125,000	6,375
Coal, minerals, and products	$82,832	465,591	548,423	83,855
Fertilizers	....	1,875	1,875	50
General merchandise	....	20,000	17,839,500	178.851
Sundries	....	....	137,052	4,283
Total	82,832	623,466	18,662,850	274,014

Gain over last year, unknown.

Transportation lines established during the year, none reported.

The entrance and departures of vessels from this waterway are estimated as follows:

Class.	No.	Average draft.	Average tonnage.
STEAM.		*Feet.*	*Tons.*
Freight and passenger	850	12	1,500
Freight, mainly	75	10	1,000
Fishing	75	6	25
Tugs	300	7	30
SAIL.			
Freight	2,000	10	150
Fishing boats	1,000	6	30
Pleasure boats, small	2,000	2½	....

C 19.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

WRECK OF WEYBOSSET.

From the wreck of the schooner *Weybosset* removed in 1891 from near the bell buoy on Pollock Rip Shoal the following property was recovered. This property was sold at auction at Hyannis, Mass., on July

15, 1891, and the proceeds, $120, were turned into the Treasury in accordance with the provisions of the river and harbor act of 14 June, 1880: 1 anchor (about 2,500 pounds), 1 anchor (about 300 pounds), 1 chain (about 135 fathoms), 1 lot of junk, 1 windlass, 1 capstan, and 1 lot of paving blocks (10,000 to 11,000.)

WRECK OF LUCY JONES.

The schooner *Lucy Jones* was in the month of February, 1892, reported as having sunk in 12 fathoms depth of water in location approximately three-eighths of a mile northwest of Cross Rip Light-Ship in Nantucket Sound, by collision with steamer *City of Savannah*. The vessel was at that time loaded with brimstone and her measurements were approximately as follows: length, 100 feet; breadth, 23 feet; depth, 7 feet; gross tonnage, 122.87 tons.

Under authority of the War Department, dated February 11, 1892, the masts, spars, and rigging of this wreck were immediately removed to a depth of 50 feet below mean low water, at a total cost of $125. No property worth selling was recovered from the wreck. This work was all done during the months of February and March, by the Davis Coast-Wrecking Corporation, of New Bedford, Mass., as contractors, and under Mr. W. B. Poland as inspector.

WRECK OF ALLIE OAKES.

The schooner *Allie Oakes* was in the month of August, 1891, reported as having sunk in about 15 feet depth of water in location approximately 2,000 feet north of the eastern end of Hyannis Breakwater through having sprung a leak.

The vessel was at that time loaded with lime, and her measurements were approximately as follows: Length, 197 feet; breadth, 23.3 feet; depth, 7 feet; gross tonnage, 127.1 tons.

Under the provisions of section 4 of the river and harbor act of June 14, 1880, the wreck was duly advertised and contract entered into for its removal (see attached abstract of proposal) by Mr. Charles W. Johnston, of Lewes, Del., as contractor; and under Mr. G. F. Rostock, as inspector, work was commenced November 9, 1891, and completed November 17, 1891.

No property was recovered from the wreck.

Abstract of proposals for removing wreck of schooner Allie Oakes, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated September 26, 1891, and opened at 12 o'clock noon on Monday, October 26, 1891.

No.	Name and address of bidder.	Amount of bid.
1	Charles W. Johnston. Lewes, Del	$935
2	Enoch Townsend, Somers Point, N. J	1,645
3	Wm. E. Chapman, New York, N. Y	1,800
4	Geo. W. Townsend, Boston, Mass	2,094
5	Hiram W. Phillips, Quincy Point, Mass	3,000

Contract awarded to Charles W. Johnston.

WRECK OF ANDREW J. YORK.

The schooner *Andrew J. York* was in the month of September, 1891, reported as having sunk in about 6½ fathoms depth of water in location approximately 7¼ miles NW. ¼ N. from Nantucket Light through having collided with steamer *Indian*.

The vessel was at that time loaded with paving stone, and her measurements were approximately as follows: Length, 114.3 feet; breadth, 30 feet; depth, 9.4 feet; gross tonnage, 228.63 tons.

Under the provisions of section 4 of the river and harbor act of June 14, 1880, the wreck was duly advertised and contract entered into for its removal (see attached abstract of proposal) by Mr. Enoch Townsend, of Somers Point, N. J., as contractor; and under Mr. A. R. Elliot and Mr. E. G. Bradbury, as inspectors, work was commenced December 12, 1891, and completed January 29, 1892.

No property was recovered from the wreck.

Abstract of proposals for removing wreck of schooner Andrew J. York, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated October 2, 1891, and opened at 12 o'clock noon on Monday, November 2, 1891.

No.	Name and address of bidder.	Amount of bid.
1	Enoch Townsend, Somers Point, N. J	$3,765
2	Charles W. Johnston, Lewes, Del	6,490
3	Boston Towboat Company, 89 State street, Boston, Mass	10,450
4	William E. Chapman, 70 South street, New York, N. Y	14,690

Contract awarded to Enoch Townsend, Somers Point, N. J.

WRECK OF MARY E. OLIVER.

The schooner *Mary E. Oliver* was in the month of October, 1891, reported as having sunk in about 22 feet depth of water in location approximately one-eighth of a mile west of Norris' wharf, in Vineyard Haven Harbor, Mass., through having sprung a leak in a gale.

The vessel was at that time loaded with feldspar, and her measurements were approximately as follows: Length, 87.3 feet; breadth, 26.2 feet; depth, 7.7 feet; gross tonnage, 147.84 tons.

Under the provisions of section 4 of the river and harbor act of 14 June, 1880, the wreck was duly advertised and contract entered into for its removal (see attached abstract of proposal) by Mr. George W. Oliver, of Portland, Me., as contractor; and under Mr. Theodore Topham, as inspector, work was commenced February 5, 1892, and completed April 20, 1892.

The following property, recovered from the wreck, was sold at auction at Vineyard Haven, Mass., on May 18, 1892, and the proceeds, $304.75, were turned into the Treasury in accordance with the provisions of the special act and section above quoted: 181 tons feldspar, 100 pounds old iron, 100 pounds old rope, 2 scoop shovels, 3 square pointed shovels, 4 double blocks, 4 single blocks, and 1 iron maul.

Abstract of proposals for removing wreck of schooner Mary E. Oliver, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated November 6, 1891, and opened at 12 o'clock noon on Tuesday, December 8, 1891.

No.	Name and address of bidder.	Amount of bid.
1	George W. Oliver, Portland, Me	$2,235
2	Enoch Townsend, Somers Point, N. J	2,735
3	Boston Towboat Company, Boston, Mass	2,745
4	Wm. Buckley, Vineyard Haven, Mass	2,900
5	Geo. W. Townsend, Boston, Mass	2,900
6	Alfred Sorensen, Somerville, Mass	2,977
7	Davis Coast Wrecking Corporation, New Bedford, Mass	3,470
8	Wm. E. Chapman, New York, N. Y	4,000
9	Chas. W. Johnston, Lewes, Del	4,900

Contract awarded to George W. Oliver.

WRECK OF PYTHON.

The schooner *Python* was in the month of September, 1891, reported as having sunk in about 5 fathoms depth of water in location approximately 1,200 feet NE. ½ E. from the bell buoy on Pollock Rip through having collided with an unknown vessel.

The vessel was at that time loaded with marble dust, and her measurements were approximately as follows: Length, 81.6 feet; breadth, 24.4 feet; depth, 7.7 feet; gross tonnage, 93.86 tons.

Under the provisions of section 4 of the river and harbor act of June 14, 1880, the wreck was duly advertised and contract entered into for its removal (see attached abstract of proposal) by the Davis Coast Wrecking Corporation of New Bedford, Mass., as contractors; and under Mr. W. Babcock Poland, as inspector, work was commenced February 1, 1892, and completed April 7, 1892. No property was recovered from the wreck.

Abstract of proposals for removing wreck of schooner Python, received at Engineer Office U. S. Army, Newport, R. I., in response to advertisement dated November 6, 1891, and opened at 12 o'clock noon on Tuesday, December 8, 1891.

No.	Name and address of bidder.	Amount of bid.
1	Davis Coast Wrecking Corporation, New Bedford, Mass	$2,973
2	Wm. E. Chapman, New York, N. Y	4,000
3	Chas. W. Johnston, Lewes, Del	5,900
4	Enoch Townsend, Somers Point, N. J	6,785

Contract awarded to Davis Coast Wrecking Corporation.

WRECK OF EDITH T. GANDY.

The schooner *Edith T. Gandy* was, in the month of October, 1891, reported as having sunk in about 42 feet depth of water, in location approximately 2½ miles southwest of Shovelful Light Vessel, Massachusetts, through having sprung a leak in a gale.

The vessel was at that time loaded with paving blocks, and her measurements were approximately as follows: Length, 123.5 feet; breadth, 27.4 feet; depth, 9 feet; gross tonnage, 251.02 tons.

Under the provisions of section 4 of the river and harbor act of June 14, 1880, the wreck was duly advertised and contract entered into for its removal (see attached abstract of proposal) by Mr. Charles W. Johnston, of Lewes, Del., as contractor; and under Mr. A. R. Elliot, as inspector, work was commenced May 4, 1892, and completed June 9, 1892. No property was recovered from the wreck.

Abstract of proposals for removing wreck of schooner Edith T. Gandy, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated January 6, 1892, and opened at 12:30 o'clock noon p. m., on Monday, February 8, 1892.

No.	Name and address of bidder.	Amount of bid.
1	Charles W. Johnston, Lewes, Del	$3,400
2	Enoch Townsend, Somers Point, N. J	4,345
3	William E. Chapman, 70 South street, New York, N. Y	8,154

Contract awarded to Charles W. Johnston.

WRECK OF FLORENCE NOWELL.

The schooner *Florence Nowell* was, in the month of October, 1893, reported as having sunk in about 23 feet depth of water in location approximately 1 mile SSW. from Pollock Rip Light Ship through collision with the light ship.

The vessel was at that time loaded with paving stone and her measurements were approximately as follows: length, 105.8 feet; breadth, 28.7 feet; depth, 8 feet; gross tonnage, 222.88 tons.

Under the provisions of section 4 of the river and harbor act of June 1, 1880, the wreck was duly advertised and contract entered into for its removal (see attached abstract of proposal) by Mr. Charles W. Johnston, of Lewes, Del., as contractor; and under Mr. A. R. Elliot, inspector, work was commenced April 7, 1892 and completed April 20, 1892. No property was recovered from the wreck.

Abstract of proposals for removing wreck of schooner Florence Nowell, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated January 6, 1892, and opened at 12 o'clock noon, on Monday, February 8, 1892.

No.	Name and address of bidder.	Amount of bid.
1	Charles W. Johnston, Lewes Del	$3,200
2	Enoch Township, Somers Point, N. J	4,365
3	William E. Chapman, 70 South street, New York, N. Y	7,194
4	Davis Coast-Wrecking Corporation, New Bedford	9,995

Contract awarded to Charles W. Johnston.

WRECK OF J. B. WOODBURY.

The schooner *J. B. Woodbury*, an old abandoned wreck, was, in April, 1892, reported as lying in 4 feet depth of water in location approximately 2 miles south of the Life-Saving Station at Monomoy, southern end of Cape Cod, and as being a source of danger to the life-saving service boats and other craft. The vessel was wrecked in about 1878. Her measurement was approximately as follows: Length, 65 feet; breadth, 16 feet; depth, 7 feet; gross tonnage, 80 tons.

Under the provisions of section 4 of the river and harbor act of September 19, 1890, the wreck was duly advertised, bids to be opened July 5, 1892.

WRECK OF BERTHA J. FELLOWS.

The schooner *Bertha J. Fellows*, an old abandoned wreck, was, in April, 1892, reported as lying in 3 feet of water in location approximately three-quarters of a mile north of the Life-Saving Station at Monomoy, southern end of Cape Cod, and as being a source of danger to the life-saving boats and other craft. The vessel was wrecked in about 1885. Her measurements were approximately as follows: Length, 70 feet; breadth, 24 feet; depth, 7 feet; gross tonnage, 90 tons.

Under the provisions of section 4 of the river and harbor act of September 19, 1890, the wreck was duly advertised, bids to be opened July 5, 1892.

C 20.

[Printed in House Ex. Doc., No. 60, Fifty-second Congress, first session.]

PRELIMINARY EXAMINATION OF MENEMSHA BIGHT, MASSACHUSETTS, AN OUTLET INTO VINEYARD SOUND ON THE NORTH SHORE OF THE ISLAND OF MARTHAS VINEYARD.

ENGINEER OFFICE, U. S. ARMY,
Newport, R. I., December 19, 1890.

GENERAL: In compliance with instructions contained in Department letter of September 20, 1890, I have the honor to submit the following report upon the preliminary examination of Menemsha Bight, so called, an outlet into Vineyard Sound on the north shore of the island of Marthas Vineyard, Mass., provided for in the river and harbor act of September 19, 1890, and made by me on 24th October last.

Menemsha Bight is an indentation in the form of a regular sweep or curve in the northern shore of the island of Marthas Vineyard, and is, at its middle point, about 3 miles east of Gay Head and about 12 miles west of Vineyard Haven.

It is exposed to winds from the west by north round by the north to northeast. About one-half mile eastward of the most southerly portion of the curve of the bight a tidal stream, which is the outlet of Menemsha Pond, empties into the bight, forming a bar across its entrance. This pond is about one-half mile from the shore of the bight, and has an area, as shown on the Coast Survey chart, of about 1 square mile.

The soundings of the pond are not given on the chart, but about two-thirds of it is said to be deep enough for large vessels.

The tidal outlet is about one-half mile long, and tortuous, with a shifting sandy bottom. Its mouth also shifts along the shore with an extreme lateral movement of about 1 mile. The pond is used as a harbor by small fishing vessels, and the fishermen reopen the mouth of the creek when it becomes so much obstructed as to make it difficult to get their vessels in and out.

Those who ask for this improvement wish to have the outlet from the pond deepened sufficiently for safe navigation by fishing vessels, and to have the channel thus formed protected from sand drifting along the shore by the construction of jetties or otherwise, so that the entrance may constitute a safe harbor of refuge for light-draft vessels. It is also desired to deepen the channel leading to the wharf.

In my opinion Menemsha Bight is worthy of improvement by the General Government, but this improvement can not be recommended at present, as a survey may disclose that it will involve an outlay incommensurate with the advantage to be gained. A survey of the locality is recommended at an estimated cost of $500.

Menemsha Bight is in the collection district of Edgartown, which is a port of entry. The amount of revenue collected at Edgartown in the last fiscal year was $310.94. The nearest light-house is Gay Head Light. The nearest fortification is fort at Clark Point, New Bedford, Mass.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Henry L. Abbot, Corps of Engineers, Division Engineer, Northeast Division.)

[First indorsement.]

NORTHEAST DIVISION, ENGINEER OFFICE,
New York, January 8, 1891.

Respectfully forwarded to the Chief of Engineers, U. S. Army.

From the facts and reasons stated in this report I consider Menemsha Bight as "worthy of improvement" in the sense in which the words are used in section 18, river and harbor act of September 19, 1890. The element of cost should ultimately determine the action of Congress in the matter, but this cost can not be known without a survey.

HENRY L. ABBOT,
Col. of Engineers, Brt. Brig. Gen., U. S. A.,
Engineer, Northeast Division.

SURVEY OF MENEMSHA BIGHT, MASSACHUSETTS, AN OUTLET INTO VINEYARD SOUND ON THE NORTH SHORE OF THE ISLAND OF MARTHAS VINEYARD.

ENGINEER OFFICE, U. S. ARMY,
Newport, R. I., November 14, 1891.

GENERAL: In compliance with Department letter of January 10, 1891, I have the honor to submit the following report of survey of Menemsha Bight, Marthas Vineyard, Massachusetts, accompanied by a sketch* of the locality.

My report of the preliminary examination of this bight was submitted December 19, 1890. The outlet referred to in that report is very narrow and tortuous, having a shifting sandy bottom, with a depth of less than 1 foot on the bar at its mouth, from which point to Menemsha Pond the depth varies from less than 1 foot to about 6 feet at mean low tide. The pond has an area of about 1 square mile, nearly one-half of which varies in depth from 15 to 20 feet, the remainder having an average depth of about 4 feet at mean low tide. All of the above depths refer to the mean low water plane of the sound.

The bar at the mouth of the outlet, acting as a natural dam, raises the mean low water plane of the pond 1.7 feet and of the outlet near the mouth 0.8 feet.

The area between Menemsha Bight and Pond is composed chiefly of sand; immediately to the east and west, however, are hills abounding with valuable pottery clays.

A further description of this part of the island, together with other valuable information relative to the construction of a harbor of refuge here, is embodied in the following letter from Prof. N. S. Shaler, of Harvard University:

HARVARD UNIVERSITY, LAWRENCE SCIENTIFIC SCHOOL,
Cambridge, Mass., November 4, 1891.

MY DEAR SIR: With reference to the need of harborage at Menemsha Bight, on the island of Marthas Vineyard, I beg leave to make the following statement:

The western portion of Marthas Vineyard, particularly the region within 2 miles of Menemsha Pond, abounds in valuable pottery clay. These clays have for a quarter of a century or more been exported to the mainland, where they find a ready sale. The difficulty with this commerce has been found in the fact that along the shore near where the clays lie there is no harborage for vessels. At Gay Head the shipment is accomplished by getting out the clay in rude cubes, the material then being conveyed in rowboats to the vessel, which has to remain at anchor half a mile or more from the shore.

---

* Not reprinted; printed in House Ex. Doc. No. 60, Fifty-second Congress, first session.

If a harbor could be made at Menemsha Creek, so that vessels drawing from 6 to 10 feet of water could find the necessary shelter, the traffic in these earths would become very large. Under the present conditions it can never assume considerable proportions.

Experience has shown that the clays from the regions about Menemsha Bight are suitable not only for pottery purposes, but serve well in the manufacture of oilcloths and fireproof paints. This region contains the only deposits which are suitable for these purposes in any part of the country north and east of New Jersey; therefore their development has an important relation to the industries of New England. The greater part of the clay now exported finds a market in Boston and the towns neighboring to that city.

The shipping industry in the region about Gay Head is already large. The grounds are known to be richer in food fishes than at any other point on the coast north of Cape Hatteras. The great difficulty which men find in this employment is that there is no place of refuge during stormy weather. There is indeed no adequate shelter for the craft which are employed in this industry nearer than Woods Holl. If a place of refuge could be provided at this point it would be greatly to the advantage of the fishermen.

The region about the mouth of Vineyard Sound is subject to sudden storms of considerable violence. When these occur small vessels are often put in jeopardy for lack of shelter. In strong gales blowing from points between northeast and southwest, around by the west, it is often difficult for vessels of say 100 tons burden or less to make their way up the channel. Any refuge which might be made at Menemsha Bight would be of very great value to those who are navigating such craft.

It is a well-known fact that Vineyard Haven is often in times of storm greatly overcrowded by shipping. Many of the accidents which happen there are due to the lack of sufficient shelter. This port is particularly dangerous to small vessels. Any place of refuge at Menemsha would serve in an important way to supplement the inadequate anchorage ground at the Haven.

If there be any other points which I may not have touched, I beg you to call my attention.

It may not be out of place to say that I have known the region about Menemsha Bight for a third of a century, and that for many years I have resorted to this part of the shore as a summering place. I may say, furthermore, that in case the Government desires to make any improvements at this point there will be no land damages whatsoever.

Yours, very truly,

N. S. SHALER.

Major LIVERMORE,
U. S. Engineers.

Those who ask for this improvement desire a safe harbor of refuge for light-draft vessels, a large number of which remain in this vicinity during the fishing season. In threatening weather these vessels find it necessary to proceed to Tarpaulin Cove, Woods Holl, or Vineyard Haven for safety, thereby frequently losing a good catch. If, however, a safe harbor were established here as many as 40 or 50 of these vessels would be enabled to reach the grounds in the early morning, when the fish are most abundant. As many as 42 catboats and 24 two-masted schooners were at work in the bight when this survey was made, and residents say that when the water on the bar was of sufficient depth as many as 40 of them sought refuge in the outlet.

It is estimated that this improvement can be made at a cost of $20,000 or $25,000 by the construction of jetties extending out from the banks on either side of the mouth of the outlet to 10 feet of water in the bight, thus confining the current and producing a scour, and by stone and brush walls so placed as to prevent the erosion of the banks of the outlet. The approximate position of the jetties and walls is indicated on the accompanying sketch by heavy lines.

In my report of the preliminary examination of this locality it was stated as follows:

> In my opinion Menemsha Bight is worthy of improvement by the General Government, but this improvement can not be recommended at present, as a survey may disclose that it will involve an outlay incommensurate with the advantages to be gained.

The survey just made shows that it is extremely doubtful whether it be possible to maintain a depth of 5 feet in this sandy formation by the means proposed, and in view of this uncertainty it is doubtful whether the present demands of commerce would justify so great an outlay.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Henry L. Abbot, Corps of Engineers, Division Engineer, Northeast Division.)

[First indorsement.]

NORTHEAST DIVISION, ENGINEER OFFICE,
New York, November 21, 1891.

Respectfully forwarded to the Chief of Engineers, U. S. Army.

This improvement belongs to the class of channel works in which success is always doubtful unless large and regularly continuous appropriations are available. I do not consider that the importance of the work will justify such expenditures.

HENRY L. ABBOT,
Colonel of Engineers, Brt. Brig. Gen., U. S. A.
Engineer Northeast Division.

C 21.

[Printed in House Ex. Doc. No. 59, Fifty-second Congress, first session.]

PRELIMINARY EXAMINATION OF CANAPITSIT CHANNEL, MASSACHUSETTS, BETWEEN THE ISLANDS OF CUTTYHUNK AND NASHAWENA (NESHAWANA).

ENGINEER OFFICE, U. S. ARMY,
Newport, R. I., December 19, 1890.

GENERAL: In compliance with instructions contained in Department letter of September 20, 1890, I have the honor to submit the following report upon the preliminary examination of Canapitsit Channel between the islands of Cuttyhunk and Neshawana, provided for in the river and harbor act of September 19, 1890, and made by me from time to time.

This channel, connecting the waters of Vineyard Sound with those of Buzzards Bay, is bounded on the east by the island of Neshawana and on the west by the island of Cuttyhunk.

The improvement desired is the deepening of the channel and the clearing of the same from obstructions, so that fishing and other light-draft vessels, when in the sound, may, in case of southerly storms, run through to Cuttyhunk Harbor, at the north end of the channel. This harbor is protected from all directions except the northeast, and in the event of a storm from this point vessels could make use of the channel to find safety on the south side of the islands.

It seems probable that the removal of a few bowlders, and a small amount of dredging, is all that will be necessary for the completion of this improvement.

Within the past year three vessels have been wrecked in this locality, one of which, the schooner *Quilp*, was removed by the General Government. Several lives have also been lost. These vessels and lives would probably have been preserved had this channel been navigable.

In my opinion Canapitsit Channel is worthy of improvement by the General Government, and a survey of the locality is recommended at an estimated cost of $200.

Canapitsit Channel is in the collection district of Edgartown, which is a port of entry. The amount of revenue collected at Edgartown in the last fiscal year was $310.94. The nearest light-house is Cuttyhunk Light. The nearest fortification is fort at Clark Point, New Bedford, Mass.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Henry L. Abbot, Corps of Engineers, Division Engineer, Northeast Division.)

[First indorsement.]

NORTHEAST DIVISION, ENGINEER OFFICE,
New York, January 8, 1891.

Respectfully forwarded to the Chief of Engineers, U. S. Army. I concur with Maj. Livermore in considering that Canapitsit Channel, between Cuttyhunk and Neshawana, is worthy of improvement.

HENRY L. ABBOTT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.,
Engineer Northeast Division.

SURVEY OF CANAPITSIT CHANNEL, MASSACHUSETTS, BETWEEN THE ISLANDS OF CUTTYHUNK AND NASHAWENA (NESHAWANA).

ENGINEER OFFICE, U. S. ARMY,
Newport, R. I., November 14, 1891.

GENERAL: In compliance with Department letter of January 10, 1891, I have the honor to submit the following report of survey of Canapitsit Channel, Massachusetts, accompanied by a sketch of the locality.*

My report of the preliminary examination of this channel was submitted December 19, 1890.

This waterway lies between the islands of Nashawena and Cuttyhunk, and connects the waters of Vineyard Sound with those of Cuttyhunk Harbor. A channel having a least depth of about 4½ feet at mean low tide and varying in width from 100 to 300 feet, with shores and bottom composed of large and small bowlders, interspersed with cobblestones and gravel, is made use of by owners of light-draft boats, who are thoroughly acquainted with the location of the large number of bowlders lying in its shoalest part.

---

* Not reprinted; printed in House Ex. Doc. No. 59, Fifty-second Congress, first session.

These obstructions cause the heavy swell, which at times comes in from the ocean, to break across the south entrance, thus preventing the passage of boats which otherwise would seek refuge in Cuttyhunk Harbor. For the same reason the Cuttyhunk life-saving crew can not make use of this channel at times when it is impossible to launch the lifeboat in the surf on the south side of the island of Cuttyhunk.

The fishermen of this island would be greatly benefited by the improvement of the channel, as it would enable them to reach the fishing grounds in the sound in the early part of the day when the largest catches are made.

The shaded lines on the accompanying sketch indicate that part of the channel from which it is proposed to remove all bowlders and to dredge to 6 feet at mean low tide. It will also be necessary to place a beacon on the rocks lying in 12 feet of water to the south of the channel. This work can be done at an estimated cost as follows, viz:

Dredging 3,000 yards bowlders, cobblestones, and gravel	$2,700
Removing 100 tons of bowlders	1,300
Contingencies, 20 per cent	800
Total	4,800

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Henry L. Abbot, Corps of Engineers, Division Engigeer, Northeast Division.)

[First indorsement.]

NORTHEAST DIVISION, ENGINEER OFFICE,
New York, November 21, 1891.

Respectfully forwarded to the Chief of Engineers, U. S. Army. I recommend the improvement of this channel in the manner proposed by Maj. Livermore.

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.,
Engineer Northeast Division.

APPENDIX D.

IMPROVEMENT OF CONNECTICUT RIVER, MASSACHUSETTS AND CONNECTICUT, AND OF RIVERS AND HARBORS ON LONG ISLAND SOUND, CONNECTICUT AND NEW YORK, AND ON SOUTHERN SHORE OF LONG ISLAND, NEW YORK.

REPORT OF COLONEL D. C. HOUSTON, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Mystic River, Connecticut.
2. Thames River, Connecticut.
3. Connecticut River, Massachusetts and Connecticut.
4. Harbor of refuge, Duck Island Harbor, Connecticut.
5. Clinton Harbor, Connecticut.
6. New Haven Harbor, Connecticut.
7. Breakwaters at New Haven, Connecticut.
8. Milford Harbor, Connecticut.
9. Housatonic River, Connecticut.
10. Bridgeport Harbor, Connecticut.
11. Black Rock Harbor, Connecticut.
12. Norwalk Harbor, Connecticut.
13. Wilsons Point Harbor, Connecticut.
14. Five Mile River Harbor, Connecticut.
15. Stamford Harbor, Connecticut.
16. Port Chester Harbor, New York.
17. Larchmont Harbor, New York.
18. Echo Harbor, New Rochelle, New York.
19. East Chester Creek, New York.
20. Greenport Harbor, New York.
21. Port Jefferson Harbor, New York.
22. Huntington Harbor, New York.
23. Glen Cove Harbor, New York.
24. Flushing Bay, New York.
25. Patchogue River, New York.
26. Browns Creek, New York.

HARBOR LINES.

27. Establishment of harbor lines at Five-Mile River Harbor, Connecticut.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., July 9, 1892.

GENERAL: I have the honor to transmit herewith the annual reports upon the works of river and harbor improvement under my charge for the fiscal year ending June 30, 1892.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Colonel, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

D 1.

IMPROVEMENT OF MYSTIC RIVER, CONNECTICUT.

Mystic River is a narrow tidal stream in the eastern part of the State of Connecticut, about 7 miles west from the boundary of the State of Rhode Island. The navigable part of the river extends in a general north-northeasterly direction for nearly 4 miles from Fishers Island Sound past the villages of Noank, Mystic River, and Mystic Bridge, above which places it receives the discharge of several small fresh-water streams. The villages of Mystic River and Mystic Bridge lie respectively on the west and east banks of the river, opposite each other and about 3 miles above Fishers Island Sound; at this point the river is crossed by a highway bridge with a draw. Nearly a half mile further down is the drawbridge of the New York, Providence and Boston Railroad, and about 1½ miles still further the village of Noank lies upon the west bank. The population of Mystic River and Mystic Bridge together is about 4,000; that of Noank about 2,000.

Directly opposite the mouth of the river lie Mystic or Ram Island and Ram Island Shoal, which cause the channel to divide and branch off sharply to the northeast and southwest. The northeast channel is 18 feet or more in depth and of sufficient width, but crooked; it is the one used by large vessels; the southwest channel opens out into a broad flat with about 12 feet available depth.

The river channel up to within about a half mile below the highway bridge had a natural low-water depth of 15 feet or more; its width, from 80 to 300 feet, was sufficient, but there were several bends in its course which made it somewhat difficult of navigation. The mean rise of tide in Mystic River is about 2½ feet.

PROJECT FOR IMPROVEMENT.

Under act of Congress of August 11, 1888, a preliminary examination of Mystic River was made. In the report on this examination, dated October 26, 1888, and printed in the Annual Report of the Chief of Engineers for 1889, Part I, page 746, a project for improvement was submitted, which consisted in dredging to make the channel 15 feet deep at mean low water and 100 feet wide, and to reduce five bends in the channel. The estimate of cost based upon the U. S. Coast Survey chart of 1882, was as follows:

160,000 cubic yards at 16 cents	$25,600
Supervision and contingencies, say	4,400
Total	30,000

The beginning of work under this project was approved by the Secretary of War, November 1, 1890, after the first appropriation for improving the river had been made, and up to July 1, 1891 the channel had been made 15 feet deep and about 50 feet wide for nearly the whole distance between the bridges, under a contract not then completed.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

At the beginning of the year a contract with the Hartford Dredging Company, of Hartford, Conn., was in force, to dredge at the rate of 14.7 cents per cubic yard of dredged material, measured in scows.

Work, which had been temporarily suspended, was resumed September 4, and the contract was completed November 9, 1891.

During the fiscal year 49,179 cubic yards of sand and mud were dredged, widening the channel between the bridges and just below the railroad bridge to widths of from 75 to 200 feet, and reducing the lower bend, opposite the Beacon, by dredging off the point on the northeast side.

The total amount dredged under this contract, from April 22, 1891, to November 9, 1891, was 60,000 cubic yards. The channel between the bridges was made from 75 to 200 feet wide and 15 feet deep; for 650 feet below the railroad bridge it was made 75 feet wide and 15 feet deep, with a depth of 12 feet for an additional width of 23 feet; at the lower bend, opposite the Beacon, the 15-foot channel was widened 75 feet for a length of 750 feet at the sharpest part of the bend, and for a distance of about 1,000 feet above it was widened 25 feet, making its present width 175 feet.

PRESENT CONDITION OF IMPROVEMENT.

The present condition of improvement is as stated above, the work under the contract above mentioned being the only public work of improvement done in this river.

PROPOSED OPERATIONS.

Future appropriations will be applied to widening and reducing the remaining bends in the channel and to maintaining the channel already dredged, in accordance with the approved project.

The average annual cost of maintenance of channels in Mystic River is estimated at $2,000.

The only appropriation made for this improvement is that of $10,000 by act of Congress approved September 19, 1890.

Mystic River is in the New London collection district, of which New London is the port of entry.

The nearest work of defense is Fort Griswold, New London Harbor, about 6 miles west. There is a light-house on Morgan Point, on the west side of the river, at its mouth.

Money statement.

July 1, 1891, balance unexpended	$8,355.67
June 30, 1892, amount expended during fiscal year	8,130.07
July 1, 1892, balance unexpended	225.60
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	10,225.60
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of contract for improving Mystic River, Connecticut, in force during the fiscal year ending June 30, 1892.

Name and address of contractor.	Subject of contract.	Date of contract.	Price per cubic yard.	Remarks.
The Hartford Dredging Company, Hartford, Conn.	Dredging	Mar. 25, 1891	14.7 cents.	Contract completed Nov. 9, 1891. 60,000 cubic yards removed

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1891, MYSTIC RIVER, CONNECTICUT, INCLUDING VILLAGES OF MYSTIC AND NOANK.

Vessels arriving and departing.

[Draft from 7 to 12 feet.]

Vessels.	No.	Total round trips.
Steamers	134	386
Sailing vessels	39	39
Barges for coal and other freight	21	505
Total	194	930

Freight by water.

Kind of freight.	Tons.	Estimated value.
Coal	6,508	$26,000
Lumber (350,000 feet)	525	6,500
Stone*	22,723	14,000
Miscellaneous	2,242	27,000
Total	31,998	73,500

* The stone is reported for the fiscal year ending June 30, 1892.

No statistics for the previous year were received, and no estimate of increase or decrease was obtainable this year. The miscellaneous item is reported as being but partial. No new lines of transportation have been established since July 1, 1891.

D 2.

IMPROVEMENT OF THAMES RIVER, CONNECTICUT.

This river is formed by the confluence of the Yantic and Shetucket rivers at Norwich, Conn., and extends southward as a tidal stream 15 miles to Long Island Sound. For 11 miles above its mouth the natural channel is from 13 to 80 feet deep, averaging over 30 feet for the first 4 miles. For 3 miles below Norwich the available depth in 1829 was but 6 feet at mean low water, where now there is 11 feet. Histories of the improvements may be found in the Annual Reports of the Chief of Engineers for 1873, page 981, and in that for 1879, Part I, page 331.

PROJECTS FOR IMPROVEMENT.

Prior to 1830 various attempts had been made by private parties or corporations to deepen the channel of this river near Norwich; the first ones were by excavation only, but subsequently stone piers were constructed perpendicular to the channel at shoal spots.

By act of March 2, 1829, Congress appropriated $150 "for making a survey of the river Thames, with a view to improve the navigation of the same, and the cost of such improvement."

The survey was made in 1829 by Capt. Hartman Bache, Corps of Engineers. At that time there were four old piers standing. In his report upon the survey, dated February 20, 1830, and printed in House of Representatives, War Department Document No. 125, Twenty-first Congress, first session, Capt. Bache submitted a project for making a channel 60 feet wide, to be either 12 or 14 feet deep at high water (9 or 11 feet at low water), by excavation, by rebuilding one of the existing piers, by adding wings to the other three, extending up and down stream, and converting them into T walls, and by building ten new piers, extending downstream in curves. The piers were to be built of riprap 3 feet wide on top, with side slopes of 45°, they were to be built to heights of from 1½ to 3½ feet above highest tide, those farthest up the stream being the highest. The piers were estimated to require 43,436 cubic yards of riprap, and the excavation was placed at 27,895 cubic yards for the 12-foot channel or 69,251 cubic yards for the 14-foot channel. The cost of the whole work was estimated at $72,650.

The project was adopted, and under appropriations of 1836, 1837, and 1838, $40,000 in all, the piers were built nearly as designed, with the exception of two of the new piers and one wing wall, which were not constructed; considerable dredging was done, but no complete records of amounts appear to have been kept.

Work was stopped in 1839 by exhaustion of appropriations.

In 1866 a petition of citizens of Norwich, asking for an appropriation for removing obstructions in the river Thames, was referred to the Chief of Engineers, and returned by him to the Secretary of War with a report describing the work done upon the river, recommending no further work upon the piers until their efficiency could be investigated satisfactorily, and stating:

> In conclusion, it is considered that should the sum of $8,000 be appropriated for the improvement of this river, to be applied during the next fiscal year, all will be accomplished that can be justifiably undertaken until a commission decides upon other efficacious methods or systems of improvement.

June 23, 1866, an appropriation of $10,000 was made for improving the river, under which a survey was made, and a project for dredging to obtain 11 feet at low water (14 feet at high water) was adopted.

Under this and succeeding appropriations up to 1878 this channel was dredged, and, as far as possible, maintained with a width of 100 feet. March 3, 1879, $12,000 was appropriated "for the improvement of Thames River to secure a 14-foot channel," and in accordance therewith the project was modified to provide for a channel of that depth at low water.

In 1882, upon the recommendation of Maj. Barlow, approved by the Board of Engineers, the project was further modified by providing for the construction of 5 dikes or training walls along the outer sides of the channel curves, with the addition of low walls on the inner sides, should they be found necessary, the width of the waterway between them increasing from 300 feet (about the full width of the river) at Thamesville, 1 mile below Norwich, to 480 feet at the lower dike.

The object of the training walls was to utilize the action of the tide to keep the channel open. They were to be built up to high-water level and to have an aggregate length of 13,800 feet. In the same year the projected width of the channel was increased to 200 feet. The improvement was designed to extend over the first 3½ miles below Norwich, and the estimated cost was—

For the five dikes or training walls	$82,800
For dredging 200 feet wide and 14 feet deep	125,280
Total	208,080

Under several appropriations up to 1888 work was carried on under this project without modification.

In May, 1888, in response to a letter from the Hon. Charles Russell, M. C., to the Secretary of War, asking the "approximate cost of completing the 16-feet-deep channel to Allyn Point and the 14-feet-deep channel to Norwich, estimates for the same were submitted as follows:

For securing, by dredging, a 16-foot channel up to Allyn Point	$24,000
For securing, by dredging, a 14-foot channel from Allyn Point to the end of the existing improvement	16,200

By act of Congress of August 11, 1888, an appropriation of $50,000 was made for continuing the improvement of Thames River, with a clause authorizing its expenditure "at any point between Norwich and New London." The project was therefore extended to include the above-described work, and as now adopted it consists in making and maintaining, by dredging and a system of training walls, a channel 200 feet wide from New London to Norwich, having 16 feet depth at low water up to Allyn Point, about 5 miles below Norwich, and 14 feet from Allyn Point to Norwich.

The additional cost of the extension of the project made in 1888, about $40,000, makes the estimate for completion $95,600. The estimated cost of annual maintenance should also be increased to $8,000.

Under this project, up to July 1, 1891, 316,139 cubic yards of sand, etc., had been dredged from the channel above Allyn Point, and 84,890 cubic yards of sand and mud from the 16-foot channels at and below Allyn Point. The three dikes farthest downstream had been built and a fourth one to about three-quarters its contemplated length.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

At the beginning of the year work was in progress under a contract with Elijah Brainard, of New York City, for dredging at the rate of 24½ cents per cubic yard of dredged material measured in scows. Under this contract, which was completed October 2, 1891, 73,419 cubic yards of material, mostly sand and gravel, were removed during the fiscal year, making a total of 101,833 cubic yards removed under this contract from May 20, 1891, to October 2, 1891.

The channel at Thamesville (1 mile below Norwich) had been made 125 feet wide and 12 feet deep at mean low water; a shoal had been removed between Perch Rock and Trading Cove Dike, making a channel 125 feet wide and 12 feet deep; also the channel opposite Fort Point had been made 125 feet wide and 14 feet deep.

PRESENT CONDITION OF IMPROVEMENT.

Of the five dikes or training walls provided for in the project, the four farthest downstream have been built at cost as follows:

	Date of completion.	Length.	Riprap, exclusive of repairs.	Cost, exclusive of supervision.
		Feet.	*Tons.*	
Mohegan, 3½ miles below Norwich	1883	2,983	(*)	$23,686.00
Trading Cove, 2¼ miles below Norwich	1882	2,370	17,207	21,113.05
Long Rock, 2 miles below Norwich	1885	2,800	11,945	12,781.15
Rolling Mill, 1½ miles below Norwich	1887	3,093	18,521	18,772.58

* Pile dike.

The Rolling Mill Dike, originally designed to be 4,350 feet long, is now 3,093 feet long, with a gap of 390 feet at the "sand pier," and extends northward nearly to the Lower Rolling Mill embankment.

The project contemplated extending it about 600 feet north of the embankment, but since its adoption the Lower Rolling Mill Company has dredged a channel toward shore on the north side of their embankment which is now used as a landing. It would be necessary to leave an opening for this channel, and probably it will be found expedient not to extend the dike above the embankment.

The upper dike, one-half mile below Norwich, has not been begun.

The low-water depth in the channel from New London to Allyn Point is not less than 16 feet, with width of 200 feet or over; from Allyn Point to the upper end of Walden Island Beach the depth is practically 14 feet and the width not less than 175 feet; above the latter point up to Norwich the depth is 11 feet or over, and the width from 75 to 150 feet.

PROPOSED OPERATIONS.

Future appropriations will be applied to completing the dikes, if necessary, and to making and maintaining a channel 200 feet wide, to be 16 feet deep at mean low water up to Allyn Point, and thence to Norwich to be 14 feet deep, as provided in the approved project.

Appropriations for the improvement of Thames River have been made as follows:

Application.	Date.	Amount.
Removal of obstructions placed during the war of 1812	Mar. 3, 1821	$150
Survey	Mar. 2, 1829	150
Piers and dredging	July 4, 1836	10,000
Do	Mar. 3, 1837	20,000
Do	July 7, 1838	10,000
Dredging and survey	June 23, 1866	10,000
Dredging	Mar. 3, 1867	72,000
Do	Mar. 3, 1871	15,000
Do	June 10, 1872	10,000
Do	June 18, 1878	10,000
Do	Mar. 3, 1879	12,000
Do	June 14, 1880	22,500
Dredging and training walls	Mar. 3, 1881	30,000
Training walls	Aug. 2, 1882	*35,000
Do	July 5, 1884	*25,000
Training walls and dredging	Aug. 5, 1886	*22,500
Repair of training walls and dredging	Aug. 11, 1888	*50,000
Dredging	Sept. 19, 1890	*20,000
Total		374,300

*Appropriated for present project; these, with $20,000 from previous appropriations (see Annual Report for 1882, Part I, page 603), make a total of $172,500 for present project.

The Thames River is in the collection district of New London. The nearest lighthouse is at the mouth of the river, on the west shore. Forts Trumbull and Griswold overlook the mouth of the river from either shore.

Money statement.

July 1, 1891, balance unexpended	$28,901.78
June 30, 1891, amount expended during fiscal year	24,360.83
July 1, 1892, balance unexpended	4,540.95
Amount appropriated by act approved July 13, 1892*	30,000.00
Amount available for fiscal year ending June 30, 1893	34,540.95
Amount (estimated) required for completion of existing project	55,600.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	55,600.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

---

*Of which $10,000 may be expended in improvement of Shaws Cove, New London Harbor.

Abstract of contract for improving Thames River, Connecticut, in force during the fiscal year ending June 30, 1892.

Name and address of contractor.	Subject of contract.	Date of contract.	Rate per cubic yard.	Remarks.
Elijah Brainard, New York City...	Dredging.....	Mar. 29, 1891	24½ cents..	Contract completed October 2, 1891, 101,833 cubic yards.

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1891, INCLUDING ALL PORTS ABOVE NEW LONDON.

Vessels arriving and departing.

[Draft from 4 to 16 feet to Allyn Point; 4 to 14 feet to Norwich.]

Vessels.	Vessels.	Total round trips.
Steamers	4	203
Sail vessels	50	287
Barges	165	940
Total	219	1,430

Freight by water.

	Tons.
Coal received	447,401
Iron received	11,802
Lumber received	12,000
Miscellaneous:	
Received	92,154
Shipped	46,211
Total	609,568

Total value of above freight roughly estimated at $30,478,400.

The above statement shows an increase over the amount reported for the previous year of 140,424 tons.

No new lines of transportation have been established since July 1, 1891.

D 3.

IMPROVEMENT OF CONNECTICUT RIVER, MASSACHUSETTS AND CONNECTICUT.

This river rises in the northern part of New Hampshire, flows in a generally southerly course between the States of New Hampshire and Vermont, crosses the States of Massachusetts and Connecticut, and empties into Long Island Sound at Saybrook Point, Conn. It is divided naturally into two parts, Hartford, Conn., at the head of navigation, being the point of division, and appropriations by Congress have generally specified in which part the money appropriated was to be expended.

The divisions are as follows:

1. *Above Hartford, Connecticut.*—Embracing a length of about 66 miles, from Hartford, Conn., to Miller Falls, Mass.

2. *Below Hartford, Connecticut.*—Embracing a length of about 50 miles, from Hartford to Long Island Sound.

By the river and harbor act of 1882 an examination or survey of the Connecticut River from Bellows Falls, Vt., to Pittsburg, N. H., was authorized. Bellows Falls is about 105 miles above Hartford, and Pittsburg is 180 miles above Bellows Falls. A preliminary examination was made, the report on which, printed in the Annual Report of the Chief of Engineers for 1884, Part I, page 659, recommended no survey and proposed no plan of improvement.

1. ABOVE HARTFORD, CONNECTICUT.

Miller Falls, Mass., is at the head of possible navigation of the Connecticut River. From this point down to Holyoke, Mass., a distance of about 32 miles, the river is susceptible of improvement, but it can not be used by vessels now, on account of a dam and falls at Holyoke, which entirely obstruct navigation. The lockage required to lift boats from the lower to the upper levels at Holyoke is about 60 feet.

From Holyoke, Mass., to Enfield Falls, Conn., a distance of 18 miles, there is a fair channel, 4 to 5 feet deep at low water, which could be made 8 feet deep. Enfield Falls or Rapids cover a stretch of river about 5 miles long, having a fall of about 32 feet at low water. The bed is rocky and very uneven, and the slope is not uniform, but consists of a succession of long shallow reaches separated by rapids.

From the foot of Enfield Falls to Hartford, a distance of 11 miles, the river has a broad, sandy, bed, with a depth of 2 to 5 feet at low water. Under a charter from the State of Connecticut, granted in May, 1824, the Connecticut River Company has constructed a canal with locks around Enfield Falls. The locks are 80 feet long, 18 feet wide and 4½ feet deep. The canal is chiefly used for water power; the company collects toll from vessels using it.

Following is a list of places in this part of the river where work has been done by the United States, with distances above the wagon bridge at Hartford:

	Miles.
Barbers Landing	4
Farmington River	5
Strongs Island	6½
Scantic River	7½

PROJECTS FOR IMPROVEMENT.

No general project for the improvement of this part of the river is on record as approved and adopted. All the work done has been under special projects for expenditure of the several appropriations. It consists of dredging at Barbers Landing in 1873, and construction of dikes or wing dams at Scantic River, Strongs Island, and Farmington River in 1871, at Farmington River and Barbers Landing in 1878, and again in 1880 and 1881.

Plans and estimates for a larger canal around Enfield Falls were submitted in 1878, and modified in 1880 (see Annual Report of the Chief of Engineers for 1881, Part I, page 566). They proposed a canal on the east bank of the river, extending from above Enfield Falls down to the mouth of the Hockanum River, opposite and just below Hartford, as the best means of gaining an available depth of 8 feet from Hartford to and around the falls. The canal levels were to be 10 feet deep at low water and 120 feet wide at the water line; the locks, 200 feet long, 55 feet wide, with 8 feet depth over the miter sills at low water. The cost of the work was estimated at $1,332,805. It was considered not advisable to begin construction with a less sum than $450,000.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

No work was done. The available money is insufficient to begin any general plan of improvement in this part of the river.

PRESENT CONDITION OF IMPROVEMENT.

The wing dams are all in fair condition; they are as follows: One at Scantic River, one at Strongs Island, one at the mouth of Farmington River, two nearly opposite the mouth of Farmington River, and two on the east bank, opposite Barbers Landing. The available channel depth from Hartford to Scantic River is about 2 feet at ordinary summer stage of water; this part of the river is navigable for freighting only when in freshet. No work has been done above Scantic River; the depth from there to the foot of Enfield Falls is greater than from there down to Hartford.

PROPOSED OPERATIONS.

No work in the river above Hartford is contemplated during the ensuing year. Should any injury to the wing dams occur, the money available will be sufficient for repairs.

Appropriations for improving the Connecticut River above Hartford have been made as follows:

Application.	Date.	Amount.
Dams at Scantic River and Strongs Island, Farmington River, and Barbers Landing; repairs of dams; dredging at Barbers Landing; surveys.	July 11, 1870	$20,000
	Mar. 3, 1871	20,000
	June 10, 1872	25,000
	Mar. 3, 1873	20,000
	June 14, 1880	15,000
Total		100,000

Of these amounts the following balance is yet unexpended: From the appropriation of June 14, 1880, for "improving Connecticut River between Hartford and Holyoke," $8,940.30.

Money statement.

July 1, 1891, balance unexpended	$8,940.30
July 1, 1892, balance unexpended	8,940.30

---

2. BELOW HARTFORD, CONNECTICUT.

The Connecticut River below Hartford is a large stream, for the first 21 miles flowing in a winding course mostly through alluvial meadows, which are overflowed at high water and which consist of a light sandy soil easily undermined. For the remaining 29 miles to Long Island Sound, at Saybrook Point, the course is straighter, the banks more permanent, and generally harder. A gauge has been established at Hartford, whose zero is the lowest stage that the water is known to have reached from natural causes; closing the gates at the Holyoke Dam in time of drought has caused the water to fall lower, The usual low-water stage of the river in the summer is about 1 foot on this gauge. Spring freshets ordinarily rise to 20 feet; the highest recorded stage of water is 29 feet.

The average tide at Saybrook is 3½ feet; at Hartford it is about 1 foot, though when the water stands above 5 feet on the Hartford gauge the tide there is not perceptible. The slope of the river from Hartford to Saybrook averages .0458 foot per mile. The bed of the river through the alluvial meadows within 10 miles of Hartford is constantly changing from the undermining of the banks. It is said that in places it has changed its position a half mile. The bars in this part of the river, after being dredged, form again during freshets and ice jams, so that some of them require being dredged annually, others less frequently. This part of the river was worked upon by corporations and by private parties at various times between 1800 and 1870. Several small stone piers to deepen the channel at shoal places were built in this way. Some of these are covered by new banks, the channel has shifted to the opposite side of others, and others still have been dredged out because they had come to be obstructions. The depth sought by these works was 6 feet at low water.

The following list gives the names of the several places on the river below Hartford where work has been done by the United States, with their distances by course of channel below the Hartford wagon bridge:

Locality.	Miles.	Locality.	Miles.
Hartford Bar	1⅛	Mouse Island Bar	20½
Clay Banks Bar	2½	Haddam Island Bar	30
Pratt Ferry or Naubuc Bar	5½	Chester Rock	38
Press Barn Bar	6¾	Brockway Bar	41
Glastonbury Bar	9½	Calves Island Bar	44½
Dividend Bar	12	Saybrook Bar (at mouth)	50
Pistol Point Bar	15		

PROJECTS FOR IMPROVEMENT.

By act of July 4, 1836, Congress appropriated $20,000 "for improving the harbor at Saybrook, by removing the bar at the mouth of the Connecticut River." Under this appropriation a survey was made by Capt. W. H. Swift, U. S. Engineer Corps. In his report on this survey, dated January 31, 1837, and printed in House Ex. Doc. No. 252, Twenty-fifth Congress, Capt. Swift submitted a project for deepening the west channel over Saybrook Bar, dredging a cut 500 feet wide and 12 feet deep at mean low water, at an estimated cost of $54,380.50. The estimated cost per cubic yard for dredging and dumping was 25 cents. The available depth over the bar before dredging was 7 feet at mean low water. Capt. Swift's project was approved, and work was begun in May, 1838, under contract with Randall, Haskell & Holmes, at the rate of 62½ cents per cubic yard, measured in scows. Dredging was continued until the fall of 1840, when the appropriation was exhausted. Twenty-six thousand nine hundred and eighty-four cubic yards of sand and stones had been removed, making a channel 1,500 feet long, 50 feet wide, and from 11 to 12 feet deep. This channel was nearly destroyed by storms and freshets in the following winter and spring. March 1, 1843, $3,471.57 was appropriated to pay a balance due to the contractors.

No further work was done upon the river until 1867.

By act of Congress approved March 2, 1867, a survey of the river was ordered, which was made in the following season, and which embraced all the principal bars and obstructions between Hartford and Long Island Sound. With the report on this survey, dated January 11, 1868, and printed on page 754, *et seq.*, of the Annual Report of the Chief of Engineers for 1868, was presented a project for improving this part of the river. It proposed dredging at Hartford, Clay Banks, Pratts Ferry, Glastonbury, and Pistol Point to make channels 8 feet deep at low water and 100 feet wide; dredging at Saybrook Bar to make a channel 8½ feet deep and 200 feet wide; piling for shore protection at Hartford and Wethersfield, and the removal of Chester Rock, at a total estimated cost of $70,000. An estimate of $10,000 for annual maintenance was submitted. All the dredging done up to 1880 was, in accordance with this project, extended to make 9 to 9½ feet depth instead of 8 feet, and also to include Press Barn, Dividend and Mouse Island bars. The piling at Hartford was built in 1871, and the removal of Chester Rock was begun in the same year, but abandoned by the contractor soon after beginning.

January 22, 1873, a project for building three jetties at Saybrook and for dredging was approved by the Secretary of War. The jetties were to be of a double row of piles, 20 feet apart, filled with stone to a height of 8 feet above low water. The dredging was to be 9 feet deep and 400 feet wide.

The estimated cost was:

Dredging	$17, 850
Jetties	318. 760
Total	336, 610

Before work on the jetties was begun the plan of construction was modified to one for building them of riprap stone, triangular cross sections rising to a level of highest water, *i. e.*, about 5 feet above mean low water, this plan being much more economical than the previous one.

The jetties were begun in 1873, and two of them were completed in 1881. The third has not been built and may not be needed; the west jetty has since been extended, and both have been repaired and strengthened.

In 1880 a project was adopted for permanent works of improvement at six of the worst bars (see Annual Report of the Chief of Engineers for 1880, Part I, page 396 *et seq*). This project provided for riprap wing dams, mattress, shore protection, and rectification of the banks at the following places, viz:

Locality.	Amount.	Locality.	Amount.
Hartford Bar	$33, 464	Press Barn Bar	$41, 140
Clay Banks Bar	69, 116	Glastonbury Bar	114, 922
Pratts Ferry or Naubuc Bar	64, 735	Dividend Bar	7, 110
		Total	330, 487

with dredging to make and maintain a permanent channel. The project did not provide for extension and repair of the Saybrook jetties, nor did the estimate include any amount for annual dredging to maintain channels, nor for dredging between the jetties at Saybrook, nor for any work whatever at Pistol Point, Mouse Island, Haddam Island,

and Calves Island bars, where dredging has since been required. All of these have consumed a large part of the appropriations made since.

Under this project, extended as above, up to the fall of 1887, a training wall of riprap 3,689 feet long had been built at Hartford Bar (instead of the proposed wing dam), and a riprap wing dam, 5,300 feet long, had been built at Glastonbury Bar, both to the height of 3 feet above low water; part of the Hartford training wall was subsequently built to 4 feet above low water; the west jetty at Saybrook had been extended to the 16-foot curve, the east jetty to the 12-foot curve, and a channel 130 feet wide and 12 feet deep had been dredged between them, besides maintaining the required depths in this part of the river, by annual dredging, at a cost of from $5,000 to $10,000 each year.

In 1887 it had become evident that the proposed plan of permanent improvement would not materially reduce the amount of dredging annually required, and that no effectual substitute could be recommended which would not be very expensive; and in December, 1887, a new project was adopted, under which future operations were to be confined to completing the jetties at the mouth of the river to a height of 5 feet above high water, with a top width of 6 feet, widening the channel between the jetties to 400 feet, with a depth of 12 feet at mean low water, and annual dredging to maintain the channel from Hartford to Long Island Sound, at an estimated cost as follows:

For completing jetties	$60,000
For dredging between jetties	20,000
Total	80,000
For average annual maintenance of channel from Hartford to Long Island Sound	10,000

The reasons for this change of project are fully given in a letter printed in the annual report of the Chief of Engineers for 1888, Part I, pages 536–538.

In 1889 a modification of this project was adopted, which provides for raising the dike at Hartford to a height of 15 feet above low water, at an estimated cost of $50,000, making the total estimate for completion at that time $130,000. The reasons for this modification are given in detail in letters to the Chief of Engineers, of October 14 and October 24, 1889, printed in the Annual Report of the Chief of Engineers for 1890, Part I, pages 614, 615.

By the river and harbor act of 1890, $12,500 was appropriated for this river, which, according to the project, was applied to annual maintenance of channels, and up to July 1, 1891, 37,763 cubic yards of sand had been removed from the channels near and below Hartford, under a contract not then completed.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

At the beginning of the year a contract with the Hartford Dredging Company, of Hartford, Conn., was in force to furnish dredging plant and to operate it at the rate of $8.20 per actual working hour of dredge. The contract was completed September 3, 1891.

During the fiscal year the dredge worked 827¼ hours, and 58,058 cubic yards of material, mostly sand, were removed, making a total of 95,821 cubic yards removed under this contract from May 19, 1891, to September 3, 1891. The total number of hours worked was 1,350. Part of the time two dredges were employed.

During the fiscal year navigable channels of 9 feet depth at low water were made as follows:

	Time.	Cubic yards dredged.
Dividend Bar	July 1 to July 4	4,014
Hartford Bar	July 6 to July 24	25,158
Clay Banks Bar	July 25 to 29	4,876
Press Barn Bar	July 29	273
Glastonbury Bar	July 29 to Aug. 10	12,439
Dividend Bar	Aug. 10 to 13	3,917
Pistol Point Bar	Aug. 24 to 28	3,350
Mouse Island Bar	Aug. 29 to 31	1,529
Haddam Island Bar	Sept. 1 to 4	2,502
Total		58,058

The varying stages of water in the river made it necessary to move from one bar before the channel there was completed, to begin work upon another where the need was more urgent.

Following are the results of work done under this contract, making channels of navigable width (generally 60 feet), and of 9 feet depth at low water:

	During year ending June 30, 1891.	During year ending June 30, 1892.	Total under contract.
	Cu. yds.	*Cu. yds.*	*Cu. yds.*
Hartford Bar	9,535	25,148	34,693
Clay Banks Bar	4,152	4,876	9,028
Press Barn Bar	9,807	273	10,080
Glastonbury Bar	12,290	12,439	24,729
Dividend Bar	1,979	7,931	9,910
Pistol Point Bar		3,350	3,350
Mouse Island Bar		1,529	1,529
Haddam Island Bar		2,502	2,502
Total			95,821

The average cost per cubic yard of this dredging, not including inspection or contingent expenses, was 11.55 cents.

After the available funds were exhausted, it is understood that dredging was continued by private parties.

PRESENT CONDITION OF IMPROVEMENT.

Nothing has been done towards annual maintenance of channels since the spring freshets; the bars on the upper part of the river have available low-water depths of 5 to 8 feet, except where they have been dredged by private parties.

The channel between the Saybrook Jetties, dredged 12 feet deep and 130 feet wide, retains nearly that depth and width.

The Hartford Dike is in fair condition; the Glastonbury Dike, built on a convex bank, is now nearly covered by the advance of the bank.

Both jetties at Saybrook are in fair condition. They should be built up to the dimensions provided for in the project, to make them permanent.

The length of dikes and jetties is as follows:

	Feet.
Hartford Dike	3,698
Glastonbury Dike	5,300
Saybrook:	
West Jetty	2,550
East Jetty	2,316

PROPOSED OPERATIONS.

Future appropriations will be applied to maintenance of the 9-foot channel in the river, completing the dike at Hartford, raising the jetties at Saybrook, and dredging between them.

Appropriations for improving the Connecticut River below Hartford have been as follows:

Application.	Date.	Amount.
Dredging at Saybrook Bar	July 4, 1836	$20,000.00
Dredging at Saybrook Bar (the unexpended balance of 1836 was reappropriated)	Mar. 3, 1839	....
Balance due contractor under previous appropriation	Mar. 1, 1843	3,471.57
Survey	Mar. 2, 1867	3,995.22
Dredging at Pratt Ferry, Pistol Point, Mouse Island; piling at Hartford	July 11, 1870	20,000.00
Dredging at Hartford, Clay Banks, Pier I, Pier J, Pratt Ferry, Glastonbury, Pistol Point, and Chester Rock	Mar. 3, 1871	35,000.00
Dredging at Pratt Ferry, Pistol Point, and Saybrook Jetty	June 10, 1872	40,000.00
Dredging at Hartford, Pratt Ferry, Glastonbury, Saybrook Jetty	Mar. 3, 1873	20,000.00
Dredging at Hartford, Pratt Ferry, Saybrook, Saybrook Jetties	June 23, 1874	20,000.00
Dredging at Hartford, Pratt Ferry, Glastonbury, Saybrook Jetties	Mar. 3, 1875	20,000.00
Dredging at Hartford, Pratt Ferry, Glastonbury, Saybrook Jetties, Salmon River dredging	Aug. 14, 1876	20,000.00
Compensation for previous dredging	1878	4,203.00
Saybrook Jetties, survey from Hartford to Rocky Hill	June 18, 1878	30,000.00
Dredging at Hartford, Press Barn, Glastonbury	Mar. 3, 1879	10,000.00
Dredging at Hartford, Glastonbury, Saybrook Jetties	June 14, 1880	10,000.00
Dredging at Hartford, Pratt Ferry, Glastonbury, Glastonbury Wing Dam, Saybrook Jetties	Mar. 3, 1881	30,000.00
Dredging at Hartford, Clay Banks, Pratt Ferry, Press Barn, Glastonbury, Dividend, Pistol Point, and Salmon River, Hartford Dike	Aug. 2, 1882	45,000.00
Dredging at Hartford, Clay Banks, Pratt Ferry, Press Barn, Glastonbury, Dividend, Pistol Point, Mouse Island, and between Saybrook Jetties; extending west jetty at Saybrook	July 5, 1884	35,000.00
Dredging at Hartford, Clay Banks, Naubuc, Press Barn, Glastonbury, Dividend, Pistol Point, and Haddam Island; repairs of Hartford Dike, and Saybrook Jetties	Aug. 5, 1886	26,250.00
Compensation for previous dredging	Mar. 3, 1885	4,745.43
Annual dredging at Hartford, Clay Banks, Press Barn, Glastonbury, Dividend, Brockways	Aug. 12, 1888	10,000.00
Annual dredging at Hartford, Clay Banks, Press Barn, Glastonbury, Dividend, Pistol Point, Mouse Island, Haddam Island	Sept. 19, 1890	12,500.00
Total	....	420,165.22

The Connecticut River is in the collection district of Hartford. By course of river the distance from Holyoke, Mass., to Hartford, Conn., is about 34 miles, and from Hartford to Long Island Sound about 50 miles.

There is a light-house on Saybrook Point, on the west shore of the river, at its mouth, and another at the end of the west jetty, besides which there are three small beacon lights in the lower part of the river, which are maintained by the United States.

Fort Trumbull, New London Harbor, Connecticut, about 16 miles east from Saybrook Point, is the nearest work of defense.

Money statement.

July 1, 1891, balance unexpended	$11,274.67
June 30, 1892, amount expended during fiscal year	10,888.61
July 1, 1892, balance unexpended	386.06
Amount appropriated by act approved July 13, 1892	20,000.00
Amount available for fiscal year ending June 30, 1893	20,386.06
Amount (estimated) required for completion of existing project	110,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	90,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of contract for improving Connecticut River, in force during the fiscal year ending June 30, 1892.

Name and address of contractor.	Date of contract.	Subject.	Price per hour.	Remarks.
The Hartford Dredging Company, Hartford, Conn.	Mar. 25, 1891	Hire of dredging plant.	$8.20	Contract completed Sept. 3, 1891-95,821 cubic yards removed.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1891, BELOW HARTFORD.

Receipts and shipments by water.

Articles.	Tons.	Estimated value.
Coal	330,000	$1,320,000
Stone (mainly from Portland)	400,000	1,800,000
Miscellaneous	275,000	45,000,000
Total	1,005,000	48,120,000

Vessels employed in this traffic.

[Draft 7 to 12 feet.]

Vessels.	Number.	Tonnage.
Owned in district:		
Steamers	15	3,800
Sail vessels	45	5,600
Barges	33	7,500
Not owned in district:		
Vessels of all kinds	90	15,500
Total	183	32,400

The decrease in freight tonnage as compared with that of 1890 is attributed to the temporary substitution of a semiweekly for a daily service, made necessary by the burning of steamer *City of Richmond* and to dullness in the stone trade.

No new lines of transportation have been established since July 1, 1891.

D 4.

IMPROVEMENT OF HARBOR OF REFUGE AT DUCK ISLAND HARBOR, CONNECTICUT.

Duck Island Harbor is a bay on the north shore of Long Island Sound, between headlands known as Menunketesuck and Kelseys Points, respectively on the east and west sides of the harbor. It is about 7 miles west of the mouth of the Connecticut River, and midway between the harbors of New Haven and New London. In this distance of 46 miles there is no secure harbor of sufficient size and depth to shelter any considerable part of the general commerce of the Sound. Duck Island Harbor has a large anchorage area with depths of 16 feet or more at low tide, and with good holding bottom. It is sheltered from the north by the mainland, partly sheltered from the east by Menunketesuck Point, and slightly sheltered from the south by Duck Island, an island about 900 feet long (north and south), by 300 feet wide, situated in the mouth of the harbor rather more than half a mile west-southwest from Menunketesuck Point.

PROJECT FOR IMPROVEMENT.

Under act of Congress of August 2, 1882, a preliminary examination of this harbor was made by Col. J. W. Barlow, Corps of Engineers, the report upon which was printed in the Annual Report of the Chief of Engineers for 1884, Part I, page 684, and in Senate Ex. Doc. No. 50, Forty-eighth Congress, first session. This report outlined two plans for improving the security of the harbor, and suggested that the adoption of a project be deferred for further consideration.

The act of Congress approved August 5, 1886, provided for a "resurvey of Duck Island Harbor on Long Island Sound, including plans, specifications, and estimates of cost for making the same a harbor of refuge." A preliminary examination, together with the recent coast survey charts, afforded all the information necessary, without a detailed survey. In my report on this examination, dated November 12, 1886, and printed (with map) in the Annual Report of the Chief of Engineers for 1887, Part I, page 641, the required plans, etc., were presented. They contemplated the construction of three riprap breakwaters, one extending westerly from Duck Island, one northeasterly from the island toward Menunketesuck Point, and the third southwesterly from Menunketesuck Point. These would shelter an area of about 115 acres, with 16 feet depth or more at low tide in case of southeast storms, with a larger area for storms from any other quarter. The harbor would have a broad western entrance with 17 feet depth and an eastern entrance between the breakwaters over 25 feet deep and about 750 feet wide. The breakwaters proposed were to be of riprap, 10 feet wide at top, which was to be 10 feet above low-water level (about 6 feet above high water), with inside slopes of 1 upon 1, and outside slopes of 2 upon 3.

The estimated cost of riprap stone was as follows:

Breakwater westerly from Duck Island, 3,000 feet long	tons..	181,000
Breakwater northeasterly from Duck Island, 1,750 feet long	do...	79,000
Breakwater southwesterly from Menunketesuck Point, 1,130 feet long	do...	41,000
Total, 301,000 tons of stone, at $1.40 per ton		$421,400
Contingencies, 10 per cent		42,140
		463,540

The beginning of work under this project was approved by the Secretary of War September 27, 1890, after the first appropriation for this harbor had been made, and up to July 1, 1891, under a contract not then completed, 5,126 tons of brownstone had been delivered and placed, building 270 feet of the breakwater, but with cross-sections of dimensions somewhat less than provided for in the original project.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

At the beginning of the year a contract was in progress with Eugene S. Belden, of Rocky Hill, Conn., to deliver riprap sandstone and build a breakwater at the rate of 94 cents per gross ton of stone delivered and placed.

During the fiscal year there was delivered and placed, under this contract, 18,336 tons of riprap, building 676 feet of breakwater.

Work was begun May 14, 1891, and the contract completed October 3, 1891. The total amount of stone delivered under the contract was

23,462 tons, and the total length of breakwater built was 946 linear feet, extending westerly from the west side of Duck Island and terminating in a depth of 15 feet at mean low water. The wall was built to a height of 7½ feet over mean low water, with top width of 5 feet and side slopes of 1 upon 1.

PRESENT CONDITION OF IMPROVEMENT.

The work done under the contract completed last year is the only public work of improvement yet done in this harbor; its condition is as described above.

PROPOSED OPERATIONS.

Future appropriations will be applied to extending breakwater already begun, to raising and widening it, and to building the other breakwaters, as provided in the approved project.

The only appropriation made for improving Duck Island Harbor, Connecticut, is the one of $25,000 made by act of Congress approved September 19, 1890.

Duck Island Harbor is in the collection district of Hartford.

The nearest light-house is at Saybrook Point, at the mouth of the Connecticut, about 8 miles eastward. There is a light vessel on Long Sand Shoal, about 5 miles to the southeast.

Fort Trumbull, New London Harbor, 21 miles east, is the nearest work of defense.

Money statement.

July 1, 1891, balance unexpended	$24,180.98
June 30, 1892, amount expended during fiscal year	22,865.88
July 1, 1892, balance unexpended	1,315.10
Amount appropriated by act approved July 13, 1892	35,000.00
Amount available for fiscal year ending June 30, 1893	36,315.10
Amount (estimated) required for completion of existing project	403,540.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of contract for improving Duck Island Harbor, Connecticut, in force during the fiscal year ending June 30, 1892.

Name and address of contractor.	Date of contract.	Subject.	Price per ton of stone.	Remarks.
			Cents.	
Eugene S. Belden, Rocky Hill, Conn.	Apr. 21, 1891	Building breakwater.	94	Contract completed October 3, 1891; 23,462 tons of stone delivered.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1891.

No statement of the number of vessels passing this harbor of refuge has been received.

It may be approximately estimated as two-thirds of the number passing New Haven Breakwater, for which the record is 137,882. The value of this commerce can not be ascertained.

D 5.

IMPROVEMENT OF CLINTON HARBOR, CONNECTICUT.

Clinton Harbor is on the north shore of Long Island Sound, about 10 miles west of the mouth of the Connecticut River. It consists of an open, shallow bay, and of the mouth of the Hammonasset River, a small stream which flows easterly in front of the town wharves, and empties into the bay. For three-quarters of a mile above its mouth the river is separated from the bay by a narrow strip of sand and marsh. About 1840 a breach was made through this strip half a mile above the mouth of the river, which diverted a considerable part of the tidal flow, and since then two shoals have formed, one just inside the river's mouth with 4.5 feet depth of water, and one out in the bay shortly before reaching the deep water of the Sound, with a depth of 4 feet. It is said that formerly there were depths of from 8 to 12 feet on both these bars, and that shoaling occurred soon after the breach was made.

PROJECT FOR IMPROVEMENT.

By act, approved March 3, 1881, Congress authorized a survey of the harbor, which was made the same year. In his report on the survey, dated January 17, 1882, and printed in the Annual Report of the Chief of Engineers for 1882, Part I, page 630, Col. Barlow, Corps of Engineers, submitted a project for restoring the original condition of the channel by closing the breach and by subsequently (should the increased tidal current not produce the deepening desired) dredging through the shoals to make a channel 100 feet wide and 6 feet deep at mean low water.

The cost of a dike to close the breach was estimated at $3,000 and the cost of the whole project, including the dredging, at $10,000.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

Nothing was done. The dredging contemplated during the spring of 1892 was deferred at suggestion of parties interested in the improvement, on the ground that at that season of the year it would work considerable injury to the oyster crop, which is one of the principal industries of the place.

PRESENT CONDITION OF IMPROVEMENT.

The dike across the breach in the beach was built in 1883, and repaired and strengthened in 1891. It contains 2,310 tons of granite, and is in good condition.

No material change in the channel has occurred since the improvement began.

PROPOSED OPERATIONS.

With the available funds it is proposed to dredge to make the channel 6 feet deep at mean low water, and as wide as may be, the work to be done at such season of the year as will least injure the oyster interests of the place. Future appropriations will be applied to completing the channel as provided for in the project.

Appropriations for improving Clinton Harbor, Connecticut, have been made as follows:

Application.	Date.	Amount.
Construction of dike	Aug. 2, 1882	$3,000
Repairs of dike and dredging	Sept. 19, 1890	3,500
Total		6,500

Clinton Harbor is in the collection district of Hartford. The nearest light-house is on Falkner Island, 8 miles southwest. Fort Hale, New Haven Harbor, 22 miles west, is the nearest work of defense.

Money statement.

July 1, 1891, balance unexpended	$3,365.22
June 30, 1892, amount expended during fiscal year	1,782.47
July 1, 1892, balance unexpended	1,582.75
Amount appropriated by act approved July 13, 1892	2,000.00
Amount available for fiscal year ending June 30, 1893	3,582.75
Amount (estimated) required for completion of existing project	1,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	1,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1891.

Arrivals and departures of vessels		90 to 100
Shipments: wood, lumber, hay, etc	tons	2,800
Receipts:		
Coal	do	1,250
Lumber, 100,000 feet, equals about	do	150
Oysters, 8,000 bushels, equals about	do	520
Draft of vessels using the harbor	feet	4½ to 7
Tonnage of vessels using the harbor	tons	30 to 150

No statistics were received for the year 1890. The figures for 1891 are estimates, and are the same as those submitted for 1889, showing no change in the amount of commerce. No new lines of transportation have been established since July 1, 1891.

D 6.

IMPROVEMENT OF NEW HAVEN HARBOR, CONNECTICUT.

New Haven Harbor is a bay on the north shore of Long Island Sound, extending about 4 miles inland and from 1 to 2 miles wide. The Mill and Quinnipiac rivers empty into the head of the harbor; they are streams of no commercial importance except for tidal navigation at or near their mouths.

The harbor channel is from 400 feet to a mile wide, with mud and sand flats on either side. When the Government began work in this harbor in 1867, the available low-water depth from the city wharves to Cranes Bar, about one-third way down the harbor, was 9 feet; thence to Fort Hale, which is about halfway down, it was 16 feet or over. A short distance below Fort Hale was a bar of very soft mud, extending across the harbor, with 13 feet available depth at mean low water.

The entrance to the harbor was partly obstructed by several sunken rocks.

PROJECTS FOR IMPROVEMENT.

Several plans for removal of certain of the rocks at the harbor entrance have been proposed and undertaken, but not completed. The removal of the harbor light-house to Southwest Ledge and the completion of the proposed system of breakwaters will obviate the necessity of further work upon these rocks.

The work of deepening the channel in this harbor has, for the most part, been done in accordance with plans presented in annual or special reports to the Chief of Engineers, the projects being adopted under subsequent appropriations and not based upon examinations or surveys ordered by Congress.

In a letter dated January 20, 1871, printed as House Ex. Doc. No. 95, Forty-first Congress, third session, and also on page 771 of the Annual Report of the Chief of Engineers for 1871, Gen. Warren, U. S. Engineers, states that "the business of New Haven requires that there should be a channel dredged 200 feet wide and to a depth of 14 feet at mean low water up to the wharves," and that this is "in many respects more important to New Haven than the removal of the rocks at the entrance of the harbor." It was estimated to cost $64,815.

March 3, 1871, $40,000 was appropriated for this harbor, and it was expended in the same year in making a channel 13 feet deep, 200 feet wide up to Long Wharf, 350 feet wide at the bend at Long Wharf, and 100 feet wide from there to the steamboat wharf.

In a letter of December 23, 1871, printed in House Ex. Doc. No. 137, Forty-second Congress, first session, Gen. Warren submitted an estimate of $26,250 for dredging 16 feet deep and 200 feet wide across Fort Hale Bar, adding that there was some doubt as to the permanence of such a channel. June 10, 1872, $15,000 was appropriated for the removal of rocks and $20,000 for harbor improvement. The former amount was expended upon Luddington Rock; the latter, with part of an appropriation of $25,000, made March 3, 1873, was expended in dredging on Fort Hale Bar, and at the close of the season of 1873 the channel had been made 16 feet deep and 200 feet wide, as proposed. It soon filled to nearly its former condition. The 13-foot channel above Long Wharf was widened to 110 feet in the same year.

In the annual report for 1873 Gen. Warren says:

> It is thought that no improvement here, beyond what can be accomplished with the funds now available, is called for on the part of the United States, and no further appropriation is asked for.

No appropriation for this harbor was made in 1874, and none was recommended in the annual report of that year.

January 21, 1875, the House of Representatives, by resolution, asked "for a report from surveys already made in regard to the expediency of widening and deepening the main channel of New Haven Harbor, Connecticut, to a depth not exceeding 20 feet, and also the expediency and estimate of cost of a breakwater." In a report dated January 27, 1875, Col. Barlow, U. S. Engineers, then in charge, submitted the following estimates in reply to that part of the resolution relating to the channel (see Annual Report of the Chief of Engineers for 1875, Part II, page 250).

For channel 400 feet wide and 20 feet deep	$416,490
For channel 400 feet wide and 18 feet deep	276,990
For channel 300 feet wide and 20 feet deep	329,925
For channel 300 feet wide and 18 feet deep	208,890

Also, February 8, 1875, in reply to request from the Chief of Engineers, he estimated $10,000 as the cost of widening to 200 feet the 13-foot channel above Long Wharf, already 110 feet wide.

In submitting these reports the Chief of Engineers recommended the latter work "as being of immediate importance, and whatever action may be taken upon the project of making a 20-foot channel this at least should be done." In a subsequent report on the same matter, February 9, 1875, Col. Barlow presented an estimate of $35,000 for widening the channel above Long Wharf to 400 feet; this was transmitted to the House of Representatives, by the Secretary of War, February 13, 1875, with favorable indorsement of the Chief of Engineers. The latter plan was carried out under the appropriation of $10,000, made March 3, 1875, with a balance of about $6,000 from previous appropriations, and the 13-foot channel was made 415 feet wide above Long Wharf, the price of work being much lower than had been estimated.

Nothing was appropriated for this harbor in 1876 and 1877.

In the annual report for 1877 Col. Barlow refers to the estimates submitted in his letter of January 25, 1875, and recommends that the channel below Long Wharf be made 400 feet wide and 16 feet deep, its then dimensions (200 feet wide and 13 feet deep) not affording "sufficient space for convenient navigation." The estimated cost was $40,000.

In 1878, under the appropriation of $25,000 made June 14, 1878, the channel was dredged to the length and depth proposed, with width of 300 feet.

In a letter of February 4, 1879, transmitting map of harbor examination made in December, 1878 (letter printed in the Annual Report of the Chief of Engineers for 1879, Part I, page 336), Col. Barlow recommends deepening the channel above Long Wharf and widening the channel below to secure 400 feet width, with 16 feet depth from the steamboat wharf down to Fort Hale; also dredging a channel 500 feet wide and 16 feet deep through Fort Hale Bar. The work above Fort Hale was estimated to cost $65,000; that below, $35,000. The proposed depth and slightly greater width above Fort Hale was obtained by October, 1881, under three successive appropriations of $15,000 each, made in 1879, 1880, and 1881. Nothing had been done on Fort Hale Bar.

In the annual report for 1879 a dike at Sandy Point (opposite Fort Hale) was suggested as a means of increasing the depth on Fort Hale Bar, but on account of its expensiveness was not recommended to be undertaken until dredging had been tried again.

In the annual report for 1880 (Part I, page 445), Col. Barlow renews his recommendation for dredging a channel through Fort Hale Bar 500 feet wide and 16 feet deep.

In the annual report for 1881 (Part I, page 592), after current observations and borings had been made, a dike from Sandy Point is recommended, the length to be determined experimentally as construction progresses, but to be at least 4,400 feet, which length was estimated to cost $60,000.

Under appropriation of $30,000 made August 2, 1882, a plan for this dike was submitted and referred to the Board of Engineers, by whom it was slightly modified and approved October 2, 1882.

The project, as approved, consisted of a dike connected with Sandy Point by a shore arm about 2,160 feet long and extending southward as a channel arm about 3,200 feet, the channel arm and part of the shore arm to be built of creosoted piling in double rows, filled in with stone. In 1883 the location of the shore arm was modified upon the request of oyster-growers in the vicinity, and in 1886 the method of construction was changed to use riprap instead of creosoted piling, the latter being found more expensive both to construct and to keep in repair.

The appropriations of 1882, 1886, and nearly all of 1888, were expended upon the dike, building the shore arm, and more than half of the channel arm. The appropriation of 1884 was expended in dredging under a special project for widening the channel above Long Wharf, with depths of 8 and 12 feet, and for removing part of the old piers and abutments at Tomlinsons Bridge, which bridge was at that time being rebuilt.

The present project for making a 16-foot channel across the Fort Hale Bar includes the completion of the dike and dredging a channel 400 feet wide and 16 feet deep through the bar. Revised estimates for completion, made in 1887 (see Annual Report of the Chief of Engineers for 1887, Part I, pages 599 and 600), placed the cost of completion at that time at $46,000 for the dike and $47,000 for the channel; total, $93,000. This is to be reduced by $30,000, since appropriated, making the present estimate for completion $63,000.

Up to July 1, 1891, the shore arm and 2,089 linear feet of the channel arm of the dike had been built. No dredging had been done on Fort Hale Bar since 1873, and the available depth there was about 13 feet at mean low water; above Fort Hale the channel had been made 16 feet deep at mean low water and from 400 to 700 feet wide.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

Nothing was done.

PRESENT CONDITION OF IMPROVEMENT.

The available depth over Fort Hale Bar is about 13 feet at mean low water. Above the bar there is a 16-foot channel up to Tomlinsons Bridge, at the head of the harbor, with from 400 to 700 feet width.

Of the Sandy Point Dike, the shore arm, 2,140 feet long and 2,089 feet of the channel arm (including an ice breaker 20 feet long), have been built; 1,294 feet of the inner end of the shore arm are of riprap; the outer part of the shore arm, 846 feet long and 254 feet of the north end of the channel arm, are built of two rows of creosoted piling, 8 feet apart from out to out, and filled in with stone; 1,815 feet of the channel arm south of the pile work are built of riprap, of which the north 273 feet are on a log foundation; the ice breaker at the north end of the channel arm is also of heavy riprap on log foundation. Parts of the dike have settled from 1 to 2 feet.

PROPOSED OPERATIONS.

Future appropriations will be applied to extending the dike or to dredging the channel, or to both. The estimated cost of completing these works is $63,000, to which should be added an estimate of $5,000 annually required for maintenance of channels and repair of dike.

Appropriations for the improvement of New Haven Harbor have been made as follows:

Application.	Date.	Amount.
Removal of Middle Rock, not expended until 1867	Aug. 30, 1852	$6,000
Removal of rocks	July 11, 1870	15,000
Dredging (13 feet) above Fort Hale	Mar. 3, 1871	40,000
Dredging (16 feet) Fort Hale Bar and removal of rocks	June 10, 1872	35,000
Dredging (16 feet) Fort Hale Bar	Mar. 3, 1873	25,000
Dredging (13 feet) above Long Wharf	Mar. 3, 1875	10,000
Dredging (16 feet), Long Wharf to Fort Hale	June 18, 1878	25,000
Dredging (16 feet) above Long Wharf	Mar. 3, 1879	15,000
Do	June 14, 1880	15,000
Dredging (16 feet), Long Wharf to Fort Hale	Mar. 3, 1881	15,000
Sandy Point Dike	Aug. 2, 1882	30,000
Dredging (18, 12, and 8 feet) above Long Wharf	July 5, 1884	10,000
Sandy Point Dike	Aug. 5, 1886	20,000
Do	Aug. 11, 1888	15,000
Dredging	Sept. 19, 1890	15,000
Total		291,000

New Haven, the port of entry for the collection district of New Haven, is situated at the head of New Haven Harbor, about 3¼ miles from Long Island Sound.

There is a light-house on Southwest Ledge, at the mouth of the harbor.

Fort Hale, 2 miles below the city, commands the channel.

Money statement.

July 1, 1891, balance unexpended	$9,838.45
June 30, 1892, amounted expended during fiscal year	9,120.05
July 1, 1892, balance unexpended	718.40
Amount appropriated by act approved July 13, 1892	15,000.00
Amount available for fiscal year ending June 30, 1893	15,718.40
Amount (estimated) required for completion of existing project	48,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	48,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1891.

Value of imports	$319,683.25
Value of exports	$950,699.77
Revenue receipts	$92,431.02
Foreign vessels: entered, 39; cleared, 20	59
Domestic vessels: entered, 1,118; cleared, 1,129	2,247

Tonnage of vessels owned at this port.

	Tons.
Steamers	9,435
Sailing vessels	25,826
Barges	19,201
Total	54,462

Coastwise.

Articles.	Tons.	Value.
Coal, received and shipped	840,000	$3,360,000
Iron, received	132,250	3,306,250
Lumber, received, 88,000,000 feet	132,000	2,640,000
Oysters, received and shipped	75,000	750,000
Miscellaneous merchandise, shipped	990,500	108,955,000
Miscellaneous merchandise, received	910,200	136,530,000
Total	3,079,950	255,541,250

Vessels arriving and departing.

[Draft 6 to 20 feet.]

Steamers	25,490
Sailing vessels	18,900
Barges	13,886
Total	58,276

The above figures show an increased tonnage of freights over those reported for last year of 99,550 tons.

Two new transportation lines have been established since July 1, 1891.

D 7.

CONSTRUCTION OF BREAKWATERS AT NEW HAVEN, CONNECTICUT.

New Haven Harbor is the only natural harbor of any considerable area and depth in Long Island Sound between New London Harbor, 45 miles east, and Huntington Bay, 32 miles southwest. At this point Long Island Sound is at its widest, and the broad, open mouth of the harbor left the anchorage ground exposed to storms from a southerly quarter, so that vessels driven in by stress of weather were frequently obliged to cross Fort Hale Bar, going from 2 to 4 miles up the harbor, and to anchor in the dredged channel, in order to reach secure shelter.

PROJECT.

December 15, 1874, the harbor commissioners of New Haven addressed a memorial to the members of Congress from Connecticut, asking that measures be taken "to procure appropriations by Congress for deepening the main ship channel of the harbor to 20 feet, and for constructing a breakwater from the light-house [then on Five Mile Point] to Southwest Ledge."

The memorial, printed in House Ex. Doc. No. 162, Forty-third Congress, second session, states that the breakwater contemplated would add greatly to the value of the harbor as a harbor of refuge.

January 21, 1875, a resolution was passed by the House of Representatives, asking "for a report from surveys already made in regard to the expediency of widening and deepening the main channel of New Haven Harbor, Connecticut, to a depth not exceeding 20 feet, and also the expediency and estimate of expense of a breakwater between the eastern shore of the entrance to said harbor and Southwest Ledge, so called, or such part of said distance as may be found most expedient or necessary for the protection of said harbor." In reply to this resolution a report was made by Col. J. W. Barlow, Corps of Engineers, dated January 27, 1875, printed in House Ex. Doc. above mentioned, and also in the Annual Report of the Chief of Engineers for 1875, Part II, page 251, suggesting three locations for a breakwater, viz:

1. That indicated in the resolution and terminating at Southwest Ledge.
2. A line running nearly east and west, its middle point resting upon Adams Fall Rock, about one-half mile north of Southwest Ledge.
3. A line 400 yards farther north, running nearly west from Five Mile Point.

Estimates of cost ranging from $248,000 to $465,330 were submitted, and with the report were also presented letters and commercial statistics bearing upon the subject.

The question of a westerly breakwater does not appear to have been considered at that time.

This report is referred to by Col. Barlow in the succeeding annual reports for 1876, 1877, and 1878, and in the latter year additional statistics were submitted, but no action was taken until 1879, when an appropriation of $30,000 was made for the "construction of a breakwater at New Haven, Conn."

In August of the same year an examination of part of the mouth of the harbor was made and a map transmitted to the Chief of Engineers with several projects for breakwaters, which were referred to the Board of Engineers for report.

The report of the Board, dated November 24, 1879, and printed in the Annual Report of the Chief of Engineers for 1880, Part I, pages 449 to 452, recommended a breakwater from Southwest Ledge to Quixes Ledge, as contemplated in the resolution of the House of Representatives of January 21, 1875, but as the anchorage ground would still be exposed to southwesterly gales the Board stated as its opinion that a breakwater extending northwest from Luddington Rock would be necessary. Their plan provided for two riprap breakwaters, 12 feet wide on top, rising 6 feet above high water, with exterior slopes of 1 on 3 and interior slopes of 2 on 3, with estimates as follows:

Estimates for breakwater from Light-house Ledge to Quixes Ledge.

Length of construction ....yards..	1,100
Average height of work..feet..	32
Average cross section ....yards..	299
Cost per cubic yard	$2
328,900 cubic yards, at $2..	$657,800

Estimates for breakwater in vicinity of Luddington Rock.

Length ....yards..	1,400
Average height..feet..	28
Cross section ....square yards..	233⅓
326,667 cubic yards, at $2..	$653,334

This plan locates the easterly breakwater so as to lie between Light-house Ledge (or Southwest Ledge) and Quixes Ledge, and the westerly one to extend in a northwest and southeast direction, overlying Luddington Rock. The report of the Board was transmitted to the Secretary of War by the Chief of Engineers, with the suggestion that the appropriation ($30,000) be applied towards the construction of the easterly breakwater, and was approved by him January 31, 1880. Before work had been begun the details of cross section were modified, with the approval of the Chief of Engineers, so that the exterior slope should be 1 on 2 and the interior 1 on 1.

The first load of stone was delivered April 22, 1880, beginning the east breakwater at the end resting upon Southwest Ledge. Under subsequent appropriations it was extended northeasterly, and completed to and across Quixes Ledge on February 22, 1890.

The river and harbor act of 1888 provided:

> And the Chief of Engineers may, if deemed necessary, relocate the western breakwater, and the Secretary of War is authorized, in his discretion, to expend any portion of said sum in its commencement,

An examination in reference to this matter was made in the fall of 1888 and the results reported to the Chief of Engineers, in a letter dated January 26, 1889, and printed in the Annual Report of the Chief of Engineers for 1889, Part I, page 679. In my Annual Report for 1889 (see Annual Report of the Chief of Engineers for 1889, Part I, page 678) I presented a modification of the project, adapted to the present and prospective requirements of commerce of Long Island Sound. This modification contemplated the relocation of the westerly breakwater by changing its location about 6,000 feet to the southwestward, and the construction of a middle breakwater, commencing at a point 1,000 feet N. 54° E. from Luddington Rock, and extending S. 54° W., 5,000 feet, crossing the rock, and also a breakwater about 1,200 feet long, to partly close the space between Quixes Ledge and the east shore.

The cross section of these breakwaters was intended to be the same as the one from Southwest Ledge to Quixes Ledge, viz, 12 feet wide on top, the top to be 6 feet above mean high water, with outer slope of 1 upon 2, and inner slope of 1 upon 1. It was estimated that this relocation of the western breakwater, including the intermediate breakwater across Luddington Rock, would increase the cost of completion ($941,135 in 1889) by about $750,000, and the construction of the breakwater at the east shore would add about $90,000 more.

By act of Congress approved September 19, 1890, $120,000 was appropriated for "constructing breakwater at New Haven, Conn., in accordance with the plans submitted by the Chief of Engineers in Report for 1889, page 678."

The estimated cost of this project from the beginning is therefore ($1,311,134 + $750,000 + $90,000) $2,151,134, of which, up to July 1, 1892, $490,000 have been appropriated, and the estimated cost of completion of the project is $1,661,134.

Up to July 1, 1891, the east breakwater had been completed, and the westerly breakwater across Luddington Rock had been begun, about 350 linear feet being built to partial dimensions.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

At the beginning of the year work was in progress under contract for about 110,000 tons of granite, at price of $1.07 per ton placed in the breakwater crossing Luddington Rock.

Supplementary articles of agreement were entered into under date of October 6, 1891, permitting the use of Connecticut River sandstone in lieu of granite for parts of the work below low water, at the rate of $1.04 per ton.

Under this contract and supplementary articles, during the past fiscal year, 46,774 tons of granite and 24,491 tons of sandstone were delivered and placed in the work as required, building 1,630 linear feet of the breakwater. The contract is not yet completed.

The present length of the breakwater, all built under the above contract, is 1,980 feet, of which 500 feet are northeastwardly and 1,480 feet southwestwardly from Luddington Rock. It contains 89,284 tons of stone, 64,793 tons being granite and 24,491 tons sandstone.

In order to cover the distance and secure shelter more rapidly this work was first built to a height of only 3 feet above high water, with top width of 6 feet and side slopes of 1 upon 1. A succession of heavy storms showed that this cross section was not sufficient and it has since been increased, making the top width 8 feet and height 5 feet above mean high water.

A supplementary contract, dated March 14, 1892, provides for payment for work of increasing cross section at rate of 10 cents per ton in addition to the contract prices for not to exceed 10,000 tons, that being the estimated amount needed to enlarge the part of the breakwater built at that date.

PRESENT CONDITION OF WORK.

The east breakwater was completed February 22, 1890; it is 3,450 feet long, extending from the foundation of the light-house on Southwest Ledge northeasterly to and across Quixes Ledge, terminating in a depth of 16 feet of water at the edge of the east entrance channel. It contains 293,777 tons of riprap, and the average cost (supervision, etc., included) has been $102.50 per linear foot. The whole work is in good condition.

The middle breakwater, crossing Luddington Rock, is as described in the preceding section.

PROPOSED OPERATIONS.

With the available funds and under the existing contract the breakwater will be extended southwestwardly about 350 feet.

Future appropriations will be applied to completing this breakwater and to carrying out the project as adopted.

Appropriations for breakwaters at New Haven have been made as follows:

Application.	Date.	Amount.
Easterly breakwater	Mar. 3, 1879	$30,000
Do	June 14, 1880	30,000
Do	Mar. 3, 1881	60,000
Do	Aug. 2, 1882	60,000
Do	July 5, 1884	40,000
Do	Aug. 5, 1886	75,000
Completing easterly breakwater	Aug. 11, 1888	75,000
Middle breakwater	Sept. 19, 1890	120,000
Total		490,000

New Haven, the port of entry for the collection district of New Haven, is situated at the head of New Haven Harbor, about 4 miles north of the breakwaters.

There is a light-house on Southwest Ledge, the west terminus of the east breakwater.

Fort Hale, 2 miles north of the breakwater, commands the harbor channel.

Money statement.

July 1, 1891, balance unexpended		$119,914.06
June 30, 1892, amount expended during fiscal year		67,285.15
July 1, 1892, balance unexpended		52,628.91
July 1, 1892, outstanding liabilities	$21,169.77	
July 1, 1892, amount covered by uncompleted contracts	22,173.72	
		43,343.49
July 1, 1892, balance available		9,285.42
Amount appropriated by act approved July 13, 1892		120,000.00
Amount available for fiscal year ending June 30, 1893		129,285.42
Amount (estimated) required for completion of existing project		1,541,134.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of contracts for construction of breakwater at New Haven, Conn., in force during the fiscal year ending June 30, 1892.

Name and address of contractor.	Date of contract.	Subject of contract.	Price per ton.
James J. Moran, Brooklyn, N. Y.*	Dec. 20, 1890	Delivering riprap granite and constructing breakwater.	$1.07
James J. Moran, Brooklyn, N. Y., supplementary to above.*	Oct. 6, 1891	Substituting Connecticut River sandstone for granite.	1.04
Do.*	Mar. 14, 1892	Enlarging work already built, using 10,000 tons of stone, at additional price of	.10

* In progress.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1891.

Vessels passing New Haven Breakwater.

Men of war	42
Steamships	2,450
Steamers of all kinds	41,690
Ships, barks, and brigs	1,280
Schooners and sloops	56,620
Barges in tow	35,800
Total	137,882

This is 4,142 more vessels than reported for the previous year. In neither case are the records complete, as many vessels pass unobserved in the night or during thick weather.

The value of this commerce can not be ascertained.

D 8.

IMPROVEMENT OF MILFORD HARBOR, CONNECTICUT.

This harbor is on the north shore of Long Island Sound, about 9 miles southwest of New Haven, Conn. It consists of a broad, open bay, from the head of which the Wepauwog River, a small tidal stream, extends three-quarters of a mile north to the Milford wharves, and the Indian River, another small inlet, extends northeasterly. The mouth of the latter stream is partly closed by a dam formerly used to create power for a tide mill.

The original depth on the bar just outside the mouth of the river was less than 2 feet at mean low water, and in some places between there and the upper wharves low tide left the channels nearly bare.

The mean rise of tide is 6.2 feet.

PROJECTS FOR IMPROVEMENT.

A survey of breakwater at Milford, Conn., was ordered by Congress in the river and harbor act of 1872. There being no breakwater, a survey of the harbor was made for a breakwater, and in his report, dated December 24, 1872 (printed as part of Ex. Doc. No. 107, Forty-second Congress, third session, and also on page 1041 of the Annual Report of the Chief of Engineers for 1873), Gen. Warren, U. S. Engineers, submitted the following plan of improvement:

1. A riprap breakwater from Welch's Point, on the east side of the mouth of the harbor	$67,000
2. Protecting the bluffs on the east shore from erosion by means of small stone jetties	5,500
3. Dredging 4 feet deep and 100 feet wide across the bar at the mouth of the river	6,250
4. A jetty on the east side of the channel to prevent dredged area from filling, and to confine the action of the tide	5,000
Superintendence	1,250
Total	85,000

In 1874 $5,000 was appropriated for this harbor, and work under the above project was begun, building the small jetties to protect the east shore. Twelve such jetties were built, 100 to 130 feet long, and rising to 9 feet above mean low water. The appropriation of 1875 ($13,000) was applied to the repair of these jetties, to construction of a jetty from the east shore, at the mouth of the Indian River (Long Jetty), and to dredging across the bar.

In the Annual Report for 1876, Part I, page 2251, Col. Barlow, U. S. Engineers, recommended that the dredged channel be carried up to Town Wharf, about a half mile farther, at an additional estimated cost of $9,000.

This recommendation was renewed in 1877, and was included in the project for expenditure of the appropriation of $10,000 made in 1878. In that and the following year, the 4-foot channel across the bar was completed to 100 feet width, as originally projected, and was extended to Town Wharf, with width from 60 to 75 feet, and Long Jetty was repaired; also, under the same appropriation, in 1879 and 1880, an additional jetty, authorized by Department letter of October 16, 1879, was built on the west side of the channel, extending southward from Burns Point. This appropriation completed the original project except the breakwater; sufficient money for beginning that had not been appropriated.

June 14, 1880, $5,000 was appropriated, and in accordance with a project for its expenditure, submitted and approved, the 4-foot harbor channel was extended from Town Wharf to the Straw Works Wharf, at the upper end of the harbor, with a width of 40 feet. This was completed before the appropriation was exhausted, and "at the earnest solicitations of those most interested in the works of improvement there, an experimental channel, 25 feet wide and 8 feet deep, was cut through the bar at the entrance, lying within and on the west side of the channel already made. This is now of great use to the steam vessels employed in the fish-oil works at that place, and it is claimed that the increase of shipping in the harbor, particularly in the oyster business, for which those waters seem very well adapted, will soon require an 8-foot channel of fully 100 feet width. Such a channel would involve the removal of about 45,000 cubic yards more of material, principally sand and gravel, which, at ruling prices, would cost, including superintendence and incidental expenses, about $11,000." (Extract from Col. Barlow's Annual Report for 1881; see Annual Report of the Chief of Engineers for 1881, Part I, pages 598 and 599.)

Under the appropriation of $5,000, made August 2, 1882, the project above suggested was adopted, and the 8-foot channel was widened to 65 feet from the bay up to Merwins Wharf, with 100 feet width around the bend at Burns Point. In 1889 this channel was made fully 100 feet wide, and some needed repairs to Long Jetty were begun.

By act of Congress approved March 3, 1881, a survey for a breakwater and harbor of refuge at Milford Harbor was authorized. The survey was made, and a report, with estimates, was submitted January 20, 1882. This report is printed in the Annual Report of the Chief of Engineers for 1882, Part I, page 632.

Under date of December 14, 1889, Hon. O. H. Platt, United States Senate, wrote the Chief of Engineers, requesting an examination of Milford Harbor and a report upon dredging the channel to the upper wharves. This report was made December 31, 1889. In compliance with a resolution of the House of Representatives of January 18, 1890, a copy of the report was transmitted to the House, and printed as the House Ex. Doc. No. 139, Fifty-first Congress, first session; also in the Annual Report of the Chief of Engineers for 1890, Part I, page 629.

The act of Congress, approved September 19, 1890, appropriated $2,500 for this improvement. This amount was estimated in previous annual reports as required for repairs of the jetties, and, with the approval of the Chief of Engineers, granite was purchased in open market to be used in widening the base of Long Jetty, at the mouth of the Indian River, the price being $2.50 per gross ton delivered and placed; and up to July 1, 1891, 170 tons of stone had been delivered and placed, repairing about 160 linear feet of Long Jetty.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

At the beginning of the year work was in progress under open-market transaction, repairing Long Jetty, and during the fiscal year 670 tons of granite were delivered and placed, making a total of 840 tons delivered and placed, repairing and widening 390 feet on outside—that being the distance from section enlarged in 1889 to shore end of jetty—and 70 feet inside, commencing where work was completed in 1889. Work was commenced on June 10, 1891, and finished August 3, 1891.

PRESENT CONDITION OF IMPROVEMENT.

Long Jetty, as now repaired and enlarged, has dimensions as provided in the project, viz, outer slope 2 upon 3, inner slope 1 upon 1. There yet remain about 300 feet of the jetty not widened on the inside.

The channel, dredged 4 feet deep, with width of 60 feet for about two-thirds the distance, from the mouth of the river to the Straw Works Wharf and with width of 40 feet for the rest of the distance, has shoaled somewhat.

The channel across the bar is 8 feet deep and over 100 feet wide.

PROPOSED OPERATIONS.

The project is completed, and nothing further is contemplated under it except what is from time to time necessary for maintenance of the jetties and dredged channels.

No appropriation is needed for the ensuing year.

Appropriations for Milford Harbor have been made as follows:

Application.	Date.	Amount.
Survey	June 10, 1872	$1,500
Jetties on east shore	June 23, 1874	5,000
Long Jetty and dredging at mouth of river	Mar. 3, 1875	13,000
Dredging to Town Wharf	June 18, 1878	10,000
Dredging above Town Wharf and (8 feet) below Merwins Wharf, on bar	June 14, 1880	5,000
Survey for breakwater	Mar. 3, 1881	100
Dredging 8 feet on bar	Aug. 2, 1882	5,000
Dredging 8 feet on bar and repairing Long Jetty	Aug. 11, 1888	5,000
Repairing jetties	Sept. 19, 1890	2,500
Total		47,100

Milford Harbor is in the collection district of New Haven; it is about 9 miles west from Fort Hale, New Haven Harbor.

The nearest light-house is on Stratford Point, 4 miles to westward.

Money statement.

July 1, 1891, balance unexpended	$2,571.95
June 30, 1892, amount expended during fiscal year	2,396.49
July 1, 1892, balance unexpended	175.46

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1891.

Vessels arriving and departing.

[Draft, 8 to 10 feet; tonnage, 10 to 200 tons.]

Kind of vessels.	No. of vessels.	No. of round trips.
Steamers	20	2,430
Sail vessels	150	540
Barges	4	8
Total	174	2,978

The chief articles of commerce are: Coal, lumber, oysters, and general merchandise, including fish oil and fertilizers from Welch's Point, of which no complete statistics have been received. They would probably differ but little from those of 1890, when the aggregate freight tonnage was about 12,000 tons. Most of the coal, lumber, and general merchandise are now transported by rail.

No new lines of transportation have been established during the year.

D 9.

IMPROVEMENT OF HOUSATONIC RIVER, CONNECTICUT.

The Housatonic is a long, shallow river, running southward through Massachusetts and Connecticut, and emptying into Long Island Sound just east of Stratford Point, about 15 miles southwest from New Haven. At Derby, 13 miles above its mouth, it receives the discharge of the Naugatuck, a small rapid river. This point, which has been regarded as the head of navigation, is nearly the head of tide water. About a mile above there is a dam across the Housatonic River, furnishing large water power. For at least 5 miles below Derby the water is always fresh.

The original depth on the worst bars in the river (6 in number) was from 3.5 to 4.5 feet at mean low water; there was also a bar across the river's mouth with about 4 feet low-water depth.

PROJECTS FOR IMPROVEMENT.

In pursuance of a resolution of the House of Representatives, dated December 20, 1869, authorizing a survey of the Housatonic River below Derby, which resolution was referred by the Secretary of War to the Chief of Engineers for report as to the "necessity for the survey," an examination of the river from Derby to Long Island Sound was made by Col. D. C. Houston, Corps of Engineers, who reported January 8, 1870, and recommended a detailed survey of all that part of the river, at an estimated cost of $5,000. This report was printed in House Ex. Doc. No. 62, Forty-first Congress, second session.

By act of Congress approved July 11, 1870, a survey of Housatonic River below Derby, Conn., was directed, and an allotment of $2,700 was made for a survey "sufficient to determine the prominent obstructions to navigation." In his report on this survey, dated January 23, 1871, and printed in House Ex. Doc. No. 95, Forty-first Congress, third session, also in the Annual Report of the Chief of Engineers for 1871, page 781, Gen G. K. Warren, Corps of Engineers, submitted the following estimates for making a channel 7 feet deep at mean low water, to be 200 feet wide over the bar at the mouth of the river and 150 feet wide in the river, the channel at the river's mouth to be protected on the east side by a breakwater from Milford Beach.

Jetty at Sow and Pigs Reef	$4,000
Removing Drews Rock, 357 cubic yards	2,000
Dredging inside the bar at the mouth	18,486
Dredging on the bar at the mouth	12,000
Construction of breakwater at mouth	368,475

The breakwater was to be built of riprap, up to 1½ feet above mean low water, and of dimension stone above; it was to be 6 feet wide on top, rising to 11 feet above low water, and was to extend to the 6-foot curve, an estimated length of 4,200 feet.

March 3, 1871, the first appropriation for improvement of the river was made, and work in accordance with the project was begun. In 1872 the project was modified to admit of a jetty connecting Drew Rock with the west bank, instead of removal of the rock. This was done on the ground of economy, and the jetty was built in 1872. The result has been to form a bar below the jetty, which required such frequent dredging that it was found expedient to remove the rock as originally projected. This was done in 1887–1888.

Appropriations were not made in sufficient amounts to warrant beginning the breakwater as originally designed, and in 1879 Col. Barlow proposed to substitute for it a riprap jetty, at an estimated cost of $12,000.

In 1882 the estimate was changed to $20,250, the contemplated jetty being 6,000 feet long, and rising only to low-water level. Such a jetty could subsequently be built higher, if necessary, and there seems no doubt that this would have to be done before any useful effect could be realized. Therefore in my annual report for 1887 (see Annual Report of the Chief of Engineers for 1887, Part I, page 607) I presented revised estimates for a breakwater, modifying the originally proposed method of construction to one for using riprap only, experience at harbors on Long Island Sound having shown this construction to be as durable as dimension work, and more economical.

At the same time, estimates based on recent surveys for dredging, necessary to make the channel 7 feet deep, with width of 200 feet at the mouth of the river, and 100 feet above, were submitted. The latter width was adopted in 1883, because, up to that time the originally proposed width of 150 feet had never been obtained.

Following are the estimates for breakwater and for dredging submitted in 1887:

For a breakwater 5,750 feet long, extending from Milford Beach 3,250 feet in a course about south-southeast, thence parallel with and 500 feet from the channel, 2,500 feet further to the 12-foot curve; inside the bend, to be built up to 3 feet above mean low water, top width 6 feet, side slopes 1 upon 1, outside the bend to be built up to 6 feet above high water, top width 12 feet, outer slope 1 on 2, and inner slope 1 on 1	$175,000
For dredging at the mouth of the river and at six bars in the river, 146,000 cubic yards, at 16 cents, with about 15 per cent added for contingent expenses	27,000
Total	202,000

to which should be added about $1,000 annually required for maintenance of channels.

January 27, 1888, a letter further explaining the reasons for the new estimate for breakwater was submitted to the Chief of Engineers, and was subsequently printed as Senate Ex. Doc. No. 103, Fiftieth Congress, first session, and also in the Annual Report of the Chief of Engineers, for 1888, Part I, page 554.

July 1, 1891, dredging was in progress upon the bar at Shelton, at the head of navigation, to restore the 7-foot channel at that point, which had been completely filled by freshets of the previous winter and spring, and a contract for extension of the breakwater was in force, but work had not then been begun.

The river bars generally had depths of from 4 to 5 feet at mean low water, and the breakwater was 3.290 feet long, the first 3,250 feet being built to about half tide, and the last (southerly) 40 feet being built to 4 feet above high water.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

At the beginning of the year a contract was in force with Brown & Fleming, of New York City, to furnish and place in the breakwater about 20,000 tons of riprap granite, at the rate of $1.33 per ton, with a supplementary agreement, dated June 29, 1891, to admit of the use of New York City stone (gneiss) at the rate of $1.23 per ton.

Work under this contract was begun July 15, 1891, and completed May 28, 1892, the total amount of stone delivered and placed under this contract being 17,150 tons of New York City stone, extending the breakwater 1,282 feet, and making its total length 4,572 feet.

Parts of the breakwater were undermined by the currents during the winter and spring of 1890-'91. This required prompt repair, and as the existing contract provided only for extension of breakwater, with the approval of the Chief of Engineers, stone was purchased in open market for immediate use, and from July 10 to August 11, 1891, 2,654 cubic yards of riprap were purchased and placed in the work, where needed for such repairs, at the rate of $2 per cubic yard.

At the beginning of the year work was in progress under a contract with Richard Parrott, of Newburg, N. Y., to furnish dredging plant and operate it at the rate of $16 per actual working hour of dredge.

During the fiscal year the dredge worked $287\frac{44}{60}$ hours, removing 13,613 cubic yards of material, mostly sand. The contract was completed November 11, 1891.

The total amount of material removed under the contract was 15,789 cubic yards in an actual working time of $332\frac{57}{60}$ hours.

All the work was on Shelton Bar, where a channel was dredged about 1,400 feet long, with width of 60 feet, and depth of 7 feet at mean low water.

PRESENT CONDITION OF IMPROVEMENT.

The breakwater is now 4,572 feet long, and contains about 33,637 tons of stone; for 3,250 feet nearest the shore end, it is built to about half tide level; the outer 1,322 feet are built up to 4 feet above high water, with top width of 5 feet.

During the freshets of the past winter and spring the channel dredged in 1891 shoaled so that the present available depth on the bars in the river is from 4 to 5 feet at mean low water; on the outer bar the depth is about 6 feet but the channel has shifted so as to leave the entrance crooked.

PROPOSED OPERATIONS.

With the available funds it is proposed to straighten and widen a channel through the outer bar, also to deepen the channel through a shoal, about 1 mile below Stratford.

Future appropriations should be applied to making and maintaining the channel in the river, and to completing the breakwater as provided for in the approved project.

The estimated cost of completing this improvement is $132,000 to which should be added about $4,000 annually for maintenance of channels and for repairs.

Appropriations for the Housatonic River have been made as follows:

Application.	Date.	Amount.
Examination	Mar. 2, 1867	$42
Survey	July 11, 1870	2,700
Sow and Pigs Jetty, dredging	Mar. 3, 1871	15,000
Drew Rock Jetty, dredging	June 10, 1872	15,000
Dredging	Mar. 3, 1873	10,000
Do	June 23, 1874	10,000
Do	Mar. 3, 1875	5,000
Do	June 18, 1878	5,000
Do	June 14, 1880	2,000
Do	Mar. 3, 1881	2,000
Removing Drew Rock and jetty in 1887	Aug. 2, 1882	2,000
Do	July 5, 1884	2,500
Do	Aug. 5, 1886	5,000
Commencing breakwater, dredging	Aug. 11, 1888	35,000
Extending breakwater, dredging	Sept. 19, 1890	35,000
Total		146,242

The Housatonic River is the boundary between the collection districts of New Haven and Fairfield. The nearest work of defense is Fort Hale, New Haven Harbor, about 15 miles east. The nearest light-house is on Stratford Point, at the mouth of the river.

Money statement.

July 1, 1891, balance unexpended	$40,196.46
June 30, 1892, amount expended during fiscal year	29,151.78
July 1, 1892, balance unexpended	11,044.68
July 1, 1892, outstanding liabilities	5,901.00
July 1, 1892, balance available	5,143.68
Amount appropriated by act approved July 13, 1892	20,000.00
Amount available for fiscal year ending June 30, 1893	25,143.68
Amount (estimated) required for completion of existing project	112,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of contracts for improving Housatonic River, Connecticut, in force during the fiscal year ending June 30, 1892.

Name and address of contractor.	Date of contract.	Subject of contract.	Rate of payment.	Remarks.
Brown & Fleming, New York City.	Dec. 23, 1890	Delivery of riprap granite and construction of breakwater.	$1.33 per ton	Contract completed May 28, 1892; 17,150 tons of New York City stone delivered and placed.
Brown & Fleming, New York City. Supplementary to above.	June 29, 1891	Substituting New York City stone.	$1.23 per ton	
Richard Parrott, Newburg, N. Y.	Mar. 23, 1891	Hire of dredging plant.	$16 per actual working hour of dredge.	Completed Nov. 11, 1891; 15,789 cubic yards removed dur- $832\frac{11}{60}$ working hours

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1891.

At Derby and Shelton, head of navigation.

Vessels arriving and departing.	Number.	Tonnage.
Steamers	180	20,700
Sailing vessels	145	15,616
Barges	60	17,100
Total	385	53,416

Freight received and shipped.	Tons.	Value.
Lumber, 3,050,000 feet	6,850	$82,200
Coal	75,850	455,100
Paper	850	12,500
Iron	6,800	23,000
Miscellaneous:		
Received	24,905	83,207
Shipped	600	48,000
Total	115,855	704,007

At Stratford, near mouth of river.

Vessels arriving and departing.	Number.	Tonnage.
Large vessels:		
Steamers	1,000	60,000
Sailing vessels	620	38,000
Barges in tow	75	22,500
Small vessels.		
Oystermen (sail vessels)	10,000	35,000
Total	11,695	155,500

Freight received and shipped.	Tons.	Value.
Coal	40,000	$200,000
Oysters	125	12,500
Oyster shells	12,500	25,000
Miscellaneous	40,000	800,000
Total	92,625	1,037,500

The total tonnage of river freight as above reported is 208,480, being an increase of 69,680 tons over that reported for 1890.

No new lines of transportation have been established upon this river since the last annual report.

D 10.

IMPROVEMENT OF BRIDGEPORT HARBOR, CONNECTICUT.

This harbor extends nearly 3 miles inland from the north shore of Long Island Sound, its width of about 1 mile at the mouth decreasing to 200 feet between opposite wharves at its upper end. The channel, even in the widest part of the harbor, is comparatively narrow.

Before the first work by the United States was done at this harbor the depth over the bars at the harbor's mouth was about 5 feet at low water, equivalent to 11½ feet at high water, and the low-water depth above the bridges was from 2 to 7 feet.

PROJECTS FOR IMPROVEMENT.

In 1833 a petition of the citizens of Bridgeport was presented to Congress, asking an appropriation of $10,000 to improve the harbor. This was granted in 1836, and the agent in charge was instructed by the Engineer Department to dredge a channel 8 feet deep, making it 200 feet wide through the outer bar and 100 feet wide through the inner bar, or so much as the appropriation would admit of. The work was done by contract in 1837. The rate was high (understood to be 72.8 cents per cubic yard), and the funds were exhausted when the channel through the outer bar had been made 60 feet wide.

In 1838 Capt. Swift, U. S. Engineers, reported that the channel had been sounded, and was found to be 12 feet deep, or 4 feet deeper than when left by the dredger.

Nothing further was done until 1852, when a second appropriation of $10,000 was made. Capt. Dutton, U. S. Engineers, found that the channel on the outer bar was then 6 feet deep and 90 feet wide, and on the inner but 5 feet deep, and he submitted a project for dredging through both bars to a depth of 8 feet and a width of 200 feet at a total estimated cost of $32,000. This project was approved by the Secretary of War February 5, 1853, and with the $10,000 then available channels 8 to 13 feet deep were dredged 100 feet wide through the inner bar and 60 feet wide through the outer bar.

By act of Congress approved June 23, 1866, a survey of the harbor was ordered, which was made in that year. The object of the survey was to ascertain "the present state of the harbor and the character and extent of the encroachments upon it by the action of the tides," it being feared that Long Beach, on the east side of the harbor's mouth, was making northwestward by reason of sand drifting along the shore in such a way as to contract and ultimately fill up the channel above the inner bar. This work was at that time in my charge, and in my report on the survey, dated January 12, 1867, I stated that it had been proposed to construct a breakwater, extending out from Long Beach to arrest the sand, but the danger feared did not seem imminent, and I recommended a series of observations for the purpose of ascertaining the nature and amount of changes taking place.

In 1867 a survey of the shore line of Long Beach was made.

In 1868 I was directed by the Chief of Engineers to make "such resurvey of Bridgeport Harbor, Connecticut, as may be found necessary to ascertain what changes have occurred since the survey of 1866." In my report on this survey I said that the channel remained the same, and that no appropriation was needed until "the channel is found inadequate to the necessities of commerce, and then dredging must be resorted to."

In 1870 a petition of citizens of Bridgeport was presented to Congress, asking that an appropriation "be made to remove said sand bar (the outer bar) and to widen and deepen said channel and harbor in order that vessels drawing 12 feet of water may be enabled to enter without being grounded, and without the aid of lighters," and a survey or examination of the harbor was ordered.

The work was then in charge of Gen. Warren, U. S. Engineers. He made an examination of the harbor, and found it unnecessary to make further surveys. In his report, dated January 12, 1871, Gen. Warren submitted a project for dredging a channel 100 feet wide and 12 feet deep at extreme low water (or 14 feet feet deep at mean low water), and for building a pier 3,000 feet long, extending out from Long Beach, to be partly of riprap, partly of dolphins. The estimated cost of the project was $124,000. After an appropriation of $20,000 was made in 1871, work under this project was begun, dredging to depths of 12 and 13 feet at mean low water, and substituting a riprap jetty for riprap and dolphins. The jetty was completed, as far as deemed necessary, in 1873.

In 1875 the dimensions of the projected channel were modified so as to make it 12 feet deep at mean low water, and from 200 to 300 feet wide. This was accomplished in 1882.

In 1878, in compliance with the terms of the appropriation act of that year, a channel 100 feet wide and 9 feet deep was dredged from the lower bridge to the horse-railroad bridge, a distance of about 3,000 feet.

After the appropriation of 1882 a project for widening to 600 feet the channel between the inner beacon and the Naugatuck Railroad Wharf was adopted to prevent overcrowding the main channel by vessels entering to seek refuge during storms. The estimated cost was $60,000. This is nearly completed, a small area near the inner beacon remaining to be dredged.

In November, 1887, a petition was sent to the Secretary of War, signed by the mayor and other citizens of Bridgeport, asking that $10,000 be appropriated for a channel 8½ to 9 feet deep and 100 feet wide above the horse-railroad bridge. This petition, with indorsements and reports estimating $18,000 as the cost of such work, is printed in the Annual Report of the Chief of Engineers for 1889, Part I, pages 697–699.

The appropriation act of 1888 authorized this work, and the project was therefore extended to include it.

March 8, 1889, a petition was addressed to the Secretary of War by the mayor and other citizens of Bridgeport representing the necessity of a breakwater within the harbor of Bridgeport. This petition, with indorsements, is printed in the Annual Report of the Chief of Engineers for 1889, Part I, pages 700–702. The indorsements estimate the cost of a breakwater from the Tongue to the inner beacon at about $30,000, and authorize the extension of the project to include this work.

The project for improving this harbor, as thus extended, consists:

(1) In dredging to make and maintain a channel 12 feet deep at mean low water, and 300 feet wide, or more, from Long Island Sound to the lower bridge, nearly completed. Estimated cost to complete, $17,000.

(2) In dredging to make and maintain a channel 9 feet deep and 100 feet wide from the lower bridge to the head of the harbor, partly completed. Estimated cost to complete, $3,000, in addition to funds now available.

(3) In building a breakwater from the Tongue to the inner beacon, partly finished; estimated to cost $30,000, of which $15,000 have been appropriated.

It is probable that ultimately an extension of the east breakwater will be required.

Up to July 1, 1891, a breakwater had been built at Long Beach, on the east side of the harbor entrance; the channel from Long Island Sound to the lower bridge had been dredged 12 feet deep and 300 feet wide, or over. From the lower bridge to the horse-railroad bridge it had been made 100 feet wide and 9 feet deep; above the horse-railroad bridge for 1,800 feet it had been made 9 feet deep, with width from 75 to 90 feet. A contract was in force for extending this channel, but work under it had not been begun. The breakwater from the Tongue to the inner beacon had been begun, and 300 linear feet partly completed, using 750 tons of riprap, under a contract then in progress.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

At the beginning of the year construction of the breakwater between the Tongue and inner beacon was in progress under a contract with Messrs. Brown & Fleming, dated January 26, 1891, for delivering and placing riprap granite at the rate of $1.29 per gross ton.

During the fiscal year 9,077 tons of riprap were delivered and placed in the work as required, and the contract was completed December 22, 1891.

The total amount of stone delivered under this contract was 9,827 tons. The breakwater was built to cover the full distance between the Tongue and the inner beacon, 1,165 feet, having a top width of 5 feet and 3 feet above high water, with side slopes of 1 upon 1; the cross-section being made less than designed for the completed work, in order to cover the whole distance at once and prevent scouring.

Under a contract with Mr. George B. Beardsley, dated February 27, 1891, for dredging in Bridgeport and other harbors, at 14.6 cents per cubic yard, work in Bridgeport Harbor was begun December 15, 1891, and completed February 18, 1892; 30,000 cubic yards of mud, sand, and gravel being dredged. The 9-foot channel above the horse-railroad bridge was extended to within 25 feet of Winton's Dock, the upper landing in the harbor, with a width of 60 feet.

PRESENT CONDITION OF IMPROVEMENT.

The 12-foot channel is 75 feet wide on the outer bar, but for 200 feet width there is a depth of 11 feet or over; thence across the inner bar and up to the inner beacon the 12-foot channel is about 300 feet wide; thence up to the Naugatuck Railroad Wharf it is 600 feet wide; from that wharf to the lower bridge it has shoaled so that the present depth is from 10 to 11 feet.

The channel from the lower bridge to the horse-railroad bridge, dredged 9 feet deep and 100 feet wide in 1878, retains nearly that depth and width; the 9-foot channel above the horse-railroad bridge is from 60 to 90 feet wide, and about 2,600 feet long, extending to within 25 feet of the upper landing.

The breakwater at Long Beach has settled since it was built, in 1871–'73; it still serves the purpose for which it was designed, and no repairs are now needed.

The project of 1882 for making 600 feet width of channel between the inner beacon and the Naugatuck Railroad Wharf was reported completed in 1887; the inner beacon has since been rebuilt, and its location slightly changed, which makes it desirable to cut off a short point outside the new position of that beacon; this was partly done in 1888.

The breakwater from the Tongue to the inner beacon has been built to full length, but not to the cross-sections necessary for permanence.

PROPOSED OPERATIONS.

With future appropriations it is proposed to complete the channel above the bridges, to remove the shoal places above the Naugatuck Railroad Wharf, and to widen the channel eastward to the harbor line an additional width of about 200 feet; also to complete the breakwater from the Tongue to the inner beacon. The estimated cost of the above work is $35,000; it could be done to advantage in a single year.

The annual cost of maintaining the dredged channels in this harbor is estimated at $3,000.

Appropriations for the improvement of Bridgeport Harbor have been made as follows:

Application.	Date.	Amount.
Dredging outer bar	July 4, 1836	$10,000.00
Dredging outer and inner bars	Aug. 20, 1852	10,000.00
Survey	June 23, 1866	1,985.38
Do	July 11, 1870	500.00
Dredging and 521 feet of breakwater	Mar. 3, 1871	20,000.00
Dredging and 859 feet of breakwater	June 10, 1872	40,000.00
Dredging inner bar and upper harbor	Mar. 3, 1873	30,000.00
Dredging bridge to Long Island Sound (9 feet)	June 23, 1874	20,000.00
Dredging bridge to Long Island Sound (12 feet)	Mar. 3, 1875	15,000.00
Dredging upper harbor (9 feet)	Aug. 14, 1876	10,000.00
Dredging above bridge and outer bar (9 and 12 feet)	June 18, 1878	10,000.00
Dredging bridge to Long Island Sound (12 feet)	Mar. 3, 1879	10,000.00
Do	June 14, 1880	10,000.00
Dredging above inner beacon (12 feet)	Mar. 3, 1881	10,000.00
Dredging between inner beacon and railroad wharf (12 feet)	Aug. 2, 1882	10,000.00
Do	July 5, 1884	5,000.00
Do	Aug. 5, 1886	20,000.00
Dredging above horse railroad bridge (9 feet)	Aug. 11, 1888	10,000.00
Dredging and breakwater at Tongue	Sept. 19, 1890	20,000.00
Total		262,485.38

Bridgeport, the port of entry for the collection district of Fairfield, is situated about 2 miles from Long Island Sound, at the head of Bridgeport Harbor.

There is a light-house at the entrance to the harbor.

Fort Hale, New Haven Harbor, the nearest work of defense, is 18 miles east.

Money statement.

July 1, 1891, balance unexpended	$19,901.35
June 30, 1892, amount expended during fiscal year	18,491.20
July 1, 1892, balance unexpended	1,410.15
Amount appropriated by act approved July 13, 1892	20,000.00
Amount available for fiscal year ending June 30, 1893	21,410.15
Amount (estimated) required for completion of existing project	35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	35,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of contracts for improving Bridgeport Harbor, Connecticut, in force during the fiscal year ending June 30, 1892.

Name and address of contractor.	Date of contracts.	Subject.	Price per ton of stone.	Price per cubic yard dredged.	Remarks.
				Cents.	
Brown and Fleming, New York City.	Jan. 26, 1891	Delivering riprap and building breakwater.	$1.29	....	Contract completed Dec. 22, 1891; 9,827 tons.
Geo. B. Beardsley, Bridgeport, Conn.	Feb. 27, 1891	Dredging*	....	14.6	Contract completed Feb. 18, 1892; 30,000 cubic yards.

---

* Part of a contract for dredging in the harbors of Bridgeport, Black Rock, Five Mile River, and Norwalk.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1891.

Arrivals and departures of vessels.

[Draft 6 to 18 feet.]

	Number.	Tonnage.
Foreign arrivals	22	2,846
Foreign departures	21	2,202
Coastwise arrivals and departures	25,266	1,875,554
Total	25,309	1,880,602

Cargoes.

	Tons.	Estimated value.
Receipts	920,034	$42,700,000
Shipments	415,840	41,650,000
Total	1,335,874	84,350,000

The above statement of freight tonnage shows an increase of 21,717 tons over that reported for 1890.

During 1891 4,960 vessels, carrying 371,250 tons of cargoes, entered this harbor for refuge.

Custom-house receipts for year ending June 30, 1892, $195,240.

The shipment of oysters from this harbor for the year ending June 30, 1892, to domestic and foreign ports, amounted to 682,275 bushels, valued at $407,138.

No new lines of transportation have been established since July 1, 1891.

D II.

IMPROVEMENT OF BLACK ROCK HARBOR, CONNECTICUT.

This harbor, 1½ miles long from northeast to southwest and from 300 to 2,500 feet wide, lies between the mainland on the west and Fayerweather Island on the east, and includes the navigable part of Cedar Creek, a small tidal inlet which extends up into the western part of the city of Bridgeport, and affords water communication of great value to several large manufactories in its immediate neighborhood. It is in the interest of the city of Bridgeport that the improvement of Black Rock Harbor is desired.

The depth in the lower part of the harbor is from 6 to 12 feet at mean low water; this part of the harbor was formerly much used as a refuge for vessels overtaken by storms, but is not deep enough for most vessels now engaged in commerce through the Sound. Before work was done in Cedar Creek the depth there was from 2 to 4 feet, and the channel was narrow and crooked.

The head of the harbor was separated from Long Island Sound on the southeast by a broad, flat sand bar, which was bare at about half tide, and which joined Fayerweather Island with the main shore.

PROJECTS FOR IMPROVEMENT.

Between 1836 and 1838 $21,500 was expended in building a sea wall across a breach in the southern part of Fayerweather Island to preserve the light-house reservation at the south end of the island and to prevent shoaling on the anchorage ground.

In 1882 a survey of the harbor was ordered by Congress, which was made in 1883. In his report on this survey, dated December 12, 1883, Col. McFarland, U. S. Engineers, submitted a project providing—

1. For protecting the upper part of the harbor from the sea by building a breakwater over the bar northeast of Fayerweather Island, to be about half a mile long and 6 feet wide at the top, which was to be 3½ feet above mean high water or 10 feet above low water.
2. For making a channel 80 feet wide and 6 feet deep at mean low water, extending up Cedar Creek.

The estimated cost was:

Breakwater	$58,000
Dredging	22,000
Total	80,000

Work under this project was begun in 1885, and up to July 1, 1891, the breakwater had been built to its full length, in order to prevent the currents from cutting a channel across the bar, but its cross-section was less than designed, both in height and width; also a channel 6 feet deep or over, had been dredged with width of 80 feet extending from deep water northward up Cedar Creek to within 500 feet of the head of the creek, being 2,200 feet north of the Forge Company's wharf. This channel was further widened and deepened in places by private parties.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

At the beginning of the fiscal year a contract with Mr. George B. Beardsley, dated February 27, 1891, was in force, for dredging about 26,000 cubic yards at the rate of 14.6 cents per cubic yard, but work had not been begun.

Under this contract dredging was begun December 15, 1891, and the contract was completed February 27, 1892. The total amount dredged under this contract was 28,000 cubic yards; the channel from Fanchers Dock upstream for about 2,000 feet was widened by 40 feet, making its present width from 90 to 100 feet with a depth of 6 feet at mean low water; the bends at either end of the new channel were cut off, and a small shoal nearly in front of Fanchers Dock was removed.

PRESENT CONDITION OF IMPROVEMENT.

The sea wall built in 1836–1838 across a breach in Fayerweather Island is still effective in preserving the island and preventing the sea from washing over into the harbor. It needs some repair.

The breakwater between Fayerweather Island and the mainland is built to its full length, 2,744 feet, with diminished cross-section.

The 6-foot channel has been dredged to the head of navigation in Cedar Creek, the east branch of the harbor, with full projected width and depth, and is now in good condition.

Additional dredging to widen and deepen the channel in places has been done by private parties.

PROPOSED OPERATIONS.

With future appropriations it is proposed to build up the breakwater to the dimensions projected, and to maintain the present channel.

Appropriations for the improvement of Black Rock Harbor have been made as follows:

Application.	Date.	Amount.
Building sea wall on Fayerweather Island	1836–1838	$21,500
Survey	Aug. 2, 1882	350
Building breakwater and dredging	July 5, 1884	20,000
Dredging	Aug. 5, 1886	5,000
Do	Aug. 11, 1888	10,000
Do	Sept. 19, 1890	5,000
Total		61,850

Black Rock Harbor is in the Fairfield collection district, of which Bridgeport is the port of entry. There is a light-house at the harbor entrance. Fort Hale, New Haven Harbor, the nearest work of defense, is 20 miles east.

Money statement.

July 1, 1891, balance unexpended	$5,117.38
June 30, 1892, amount expended during fiscal year	4,711.75
July 1, 1892, balance unexpended	405.63
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,405.63
Amount (estimated) required for completion of existing project	35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of contract for improving harbor at Black Rock, Conn., in force during the fiscal year ending June 30, 1892.

Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.	Remarks.
George B. Beardsley, Bridgeport, Conn.	Feb. 27, 1891	Dredging *	Cents. 14.6	Contract completed February 27, 1892; amount removed 28,000 cubic yards.

---

* Part of a contract for dredging in the harbors of Bridgeport, Black Rock, Five Mile River, and Norwalk.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1891.

Freight received and shipped by water.

Articles.	Tons.	Estimated value.
Coal	44,975	$180,233.72
Iron and steel	7,875	130,050.00
Miscellaneous	6,133	148,336.70
Total	58,983	458,620.42

Vessels used in above traffic.

[Draft, 6 to 12 feet; tonnage, 50 to 450 tons.]

Steamers	137
Sailing vessels	98
Barges	260
Total	495

In addition to above, 2,800 vessels anchored for refuge in Black Rock Harbor during 1891.

The above figures show an increase in tonnage of freight over that reported for 1890 of 16,915 tons.

No new lines of transportation have been established since July 1, 1891.

D 12.

IMPROVEMENT OF NORWALK HARBOR, CONNECTICUT.

Norwalk Harbor or River is a tidal estuary, with a narrow channel extending about 3 miles north from Long Island Sound to the town of Norwalk. Above Norwalk the river is a small fresh-water stream. South Norwalk is on the west bank of the river, 1½ miles below Norwalk. At this point the river is crossed by two drawbridges, the lower one a highway bridge, and the other (450 feet above) the bridge of the New York, New Haven and Hartford Railroad.

In 1867 a company was incorporated under the laws of the State of Connecticut for the improvement of the river. Little work was done, and when improvement was begun by the United States the low-water depth to South Norwalk was 5 feet, and to Norwalk but 1 foot.

PROJECTS FOR IMPROVEMENT.

By act of March 2, 1829, Congress appropriated $80 "for making a survey of the harbor of Norwalk, Connecticut, with a view to its improvement." The survey was made by Capt. Hartman Bache, U. S. Engineers, who, in his report on the same, dated May 10, 1830, recommended excavating the channel, proposing to build a steam dredge for the purpose.

The cost was estimated as follows:

For a channel 12 feet deep at ordinary high water	$15,668.95
For a channel 10 feet deep at ordinary high water	12,286.45

No money was appropriated for carrying out this plan, and in 1871 another survey was ordered by Congress, which was made in the same year.

In his report on the latter survey, dated December 16, 1871, and printed in Senate Ex. Doc. No. 23, Forty-second Congress, second session; also in the Annual Report of the Chief of Engineers for 1872, page 900, Gen. Warren, U. S. Engineers, submitted a project for dredging a channel 6 feet deep and 100 feet wide from Long Island Sound up to Norwalk, at an estimated cost of $34,000.

In 1880 the terms of the river and harbor act provided that "so much of said appropriation ($5,000) as shall be necessary therefor shall be so expended as to have a channel 6 feet deep at low water between the steamboat landing in said Norwalk and Long Island Sound." As a channel of the projected width (100 feet) and depth of 6 feet at mean low water existed, this was interpreted as requiring a depth of 6 feet at extreme low water (see Annual Report of the Chief of Engineers for 1881, Part I, page 609), which would be of 8 feet at mean low water, and the project was accordingly modified to provide for obtaining that depth up to South Norwalk, where the steamboat landing was.

The latest estimate, made to include the cost of this modification and of a large amount of dredging already required to maintain the channel, places the total cost from the time of beginning work at $84,000.

Up to July 1, 1891, the channel below South Norwalk had been dredged 100 feet wide and 8 feet deep at mean low water, and above South Norwalk it has been made from 60 to 100 feet wide and 6 feet deep. It has shoaled in places, chiefly from subsidence and falling in of the banks.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

At the beginning of the fiscal year a contract was in force, entered into February 27, 1891, with Mr. George B. Beardsley, for dredging at the rate of 14.6 cents per cubic yard, measured in scows. Work under this contract was begun October 20, and completed December 7, 1891. The total amount dredged was 28,000 cubic yards. The location of work was along the sides of the channel, both above and below South Norwalk, removing shoals that had formed from washing in and subsidence of the banks.

PRESENT CONDITION OF IMPROVEMENT.

The channel below South Norwalk is 100 feet wide and 8 feet deep at mean low water; from South Norwalk to Norwalk it is from 60 to 100 feet wide and 6 feet deep at mean low water.

PROPOSED OPERATIONS.

The project is completed, except so far as relates to the full 100 feet width above South Norwalk. It seems inexpedient at present to attempt to maintain a greater width than now exists in this part of the harbor, and therefore no further work upon the project is at present proposed. A small amount of dredging may be needed from time to time to repair and maintain the existing channels. No appropriation is needed for the ensuing year.

Appropriations for improving Norwalk Harbor have been made as follows:

Application.	Date.	Amount.
Survey	Mar. 2, 1829	$80.00
Do	Mar. 3, 1871	1,166.66
Dredging (6 feet) above South Norwalk	June 10, 1872	10,000.00
Do	Mar. 3, 1873	10,000.00
Do	June 23, 1874	10,000.00
Dredging (6 feet) below South Norwalk	Mar. 3, 1875	7,000.00
Do	June 18, 1878	6,000.00
Dredging (6 feet) above and below South Norwalk	Mar. 3, 1879	10,000.00
Dredging (6 feet) below South Norwalk	June 14, 1880	5,000.00
Dredging (8 feet) below and (6 feet) above South Norwalk	Mar. 3, 1881	5,000.00
Dredging (6 feet) above South Norwalk	Aug. 2, 1882	5,000.00
Dredging (8 feet) below South Norwalk	July 5, 1884	5,000.00
Dredging (6 feet) above South Norwalk	Aug. 5, 1886	3,000.00
Dredging (6 feet) above and (8 feet) below South Norwalk	Aug. 11, 1888	*3,000.00
Do	Sept. 19, 1890	4,000.00
Total		84,246.66

* Part of an appropriation of $28,000, of which $25,000 was required to be expended at Wilson's Point.

Norwalk is in the Fairfield collection district, and is 11 miles west of Bridgeport, the port of entry.

Norwalk light-house is on Sheffield Island, at the harbor entrance.

The nearest work of defense is Fort Schuyler, Throgs Neck, at the head of Long Island Sound, about 29 miles southwest.

Money statement.

July 1, 1891, balance unexpended	$4,767.21
June 30, 1892, amount expended during fiscal year	4,583.68
July 1, 1892, balance unexpended	183.53

Abstract of contract for improving Norwalk Harbor, Connecticut, in force during the fiscal year ending June 30, 1892.

Name and address of contractor.	Date of contract.	Subject.	Price per cubic yard.	Remarks.
George B. Beardsley, Bridgeport, Conn.	Feb. 27, 1891	Dredging*	*Cents.* 14.6	Contract completed Dec. 7, 1891. Amount dredged, 28,000 cubic yards.

* Part of a contract for dredging in the harbors of Bridgeport, Black Rock, Five Mile River, and Norwalk,

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1891.

Arrivals and departures of vessels.

[Draft, 7 to 12 feet; tonnage, 100 to 500 tons.]

Kind of vessels.	No. of round trips.
Steamers	*1,051
Sail vessels	475
Barges and canal boats	600
Total	2,126

* I think it would be perfectly fair to add to this report, say, 100 trips each of 10 oyster steamers, with an average cargo of 40 tons each, at an average value of $10 per ton; or 1,000 trips—40,000 tons, at $40,000.

Cargoes.

Articles.	Tons.	Estimated value.
Coal	100,000	$400,000
Lumber (16,000,900 feet)	18,500	390,000
General merchandise	250,000	15,000,000
Total	368,500	15,790,000

The above figures show an increase in freight tonnage of 56,000 tons over that reported for 1890.

One new line of transportation has been established since July 1, 1891.

D 13.

IMPROVEMENT OF HARBOR AT WILSONS POINT, CONNECTICUT.

Wilsons Point Harbor is a bay on the north shore of Long Island Sound, about 1½ miles west from the mouth of Norwalk River or Harbor.

The lower half of the harbor is about half a mile wide, with depth decreasing from 16 feet gradually to 6 feet at Wilsons Point; the upper half is from 1,000 to 500 feet wide, with depth of 3 feet or less at low tide. The harbor is sheltered by the mainland and by Sheffield Island (the most westerly of the Norwalk islands), from all quarters except the southwest; it is partly sheltered from the southwest by "Bell Island," an island separated from the mainland by a marsh and narrow creek.

Wilsons Point Harbor has been used to some extent for many years as a harbor of refuge and place to lie up for the night by fishing boats and oyster steamers, and occasionally by barges caught out in storms.

There is no settlement upon the shores of the harbor, except a collection of summer cottages on Bell Island.

A few years ago the Danbury and Norwalk Railroad Company (now a branch of the Housatonic Railroad Company) made Wilsons Point their terminus, and subsequently the New England Terminal Company was formed to construct docks, car yards, and coal sheds, and to operate in the interest of the Housatonic Railroad and its connections. A large dock was built, with transfer bridges, by which freight cars were taken on board steamers, and freight carried to New York City without unloading and reloading.

PROJECTS FOR IMPROVEMENT.

March 3, 1888, a letter was sent by the Hon. William P. Frye, United States Senator, to the Secretary of War, asking that a special examination of Norwalk Harbor be made with reference to a developing business which urgently required further improvements. This letter was referred to me for report. Upon inquiry it was learned that the business referred to was that of the railroad terminus at Wilsons Point, and that it was desired that the United States undertake dredging a channel 15 feet deep and 300 feet wide up the harbor to the vicinity of the railroad wharves. There was no money available for a detailed examination of the locality, but estimates for dredging based upon recent U. S. Coast Survey charts were made as follows:

230,000 cubic yards, at 20 cents	$46,000
Contingencies, 15 per cent	6,900
Total	52,900

The river and harbor act of 1888 made appropriation for Norwalk Harbor, Conn., of $28,000, with provision as follows:

> Twenty-five thousand dollars of which shall be expended in dredging and deepening the channel in the lower harbor up to Wilsons Point.

Up to July 1, 1891, the channel had been made 15 feet deep at mean low water, and 480 feet wide from Long Island Sound up nearly to the wharves, with an additional width of 200 feet on the east side near the wharves for a length of 750 feet; close to the wharves the channel dredged by the New England Terminal Company is 12 feet deep.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

With the approval of the Chief of Engineers, dated February 14, 1891, dredging was begun February 22, 1892, under open agreement with A. J. Beardsley & Son, the rate being 8½ cents per cubic yard, the same as paid under the previous contract.

One hundred and seventy-nine thousand cubic yards of mud and sand have been dredged from the channel, making a depth of 15 feet at mean low water; the west side of the channel to the wharves was widened by about 220 feet, and a channel on the west side of the wharves was dredged 200 feet wide and about 1,300 feet long, parallel to and 75 feet distant from the wharves.

Work under this agreement was completed June 23, 1892.

PRESENT CONDITION OF IMPROVEMENT.

The channel close to the docks dredged by the Terminal Company is 12 feet deep at mean low water; outside of this is a channel 15 feet deep, extending out to deep water in Long Island Sound, about 700 feet wide, with an additional width of 200 feet on the east side for a distance of 750 feet south from the wharves.

The 15-foot channel has been extended northward parallel to the wharves and 75 feet from them, with a width of 200 feet. These channels are all in good condition, and afford easy access to the wharves for vessels of considerable depth.

PROPOSED OPERATIONS.

The improvement of this harbor is completed as far as now designed; no further work is projected and no appropriation is required.

Appropriations for improving harbor at Wilsons Point have been made as follows:

Application.	Date.	Amount.
Dredging*	Aug. 11, 1888	$25,000
Do	Sept. 19, 1890	30,000
Total		55,000

---

*Part of an appropriation of $28,000 for Norwalk Harbor, directed by the appropriation act to be expended at Wilsons Point.

Wilsons Point is in the Fairfield collection district, and is about 14 miles southwest from Bridgeport, the port of entry.

Norwalk Lighthouse, on Sheffield Island, is about half a mile south of the harbor.

The nearest work of defense is Fort Schuyler, Throgs Neck, at the head of Long Island Sound, about 29 miles southwest.

Money statement.

July 1, 1891, balance unexpended	$18,215.69
June 30, 1892, amount expended during fiscal year	9,881.99
July 1, 1892, balance unexpended	8,333.70
July 1, 1892, outstanding liabilities	6,212.87
July 1, 1892, balance available	2,120.83

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1891.

No commercial statistics for this harbor have yet been received. The amount of commerce reported for 1890 was 221,202 tons; it was probably somewhat greater for 1891.

D 14.

IMPROVEMENT OF FIVE-MILE HARBOR, CONNECTICUT.

This harbor is an inlet on the north shore of Long Island Sound, about 2 miles west of the mouth of Norwalk Harbor, Connecticut. It is about 1 mile long and from 300 to 800 feet wide. About three-quarters of a mile above its mouth it runs bare at low tide. At the mouth the depth is about 3 feet, increasing to 9 feet at a point about 750 feet out into the sound. The mean rise of tide is about 7 feet.

Since 1848 Five Mile River has been largely engaged in oyster-growing, and in this business now employs about 137 vessels.

These vessels can only enter or leave the harbor at high tide, consequently during their busy season they are obliged to lie up for the night at other and less convenient harbors.

PROJECT FOR IMPROVEMENT.

By act of Congress approved August 5, 1886, a survey or examination of this harbor was ordered, which was made in the following fall, and reported on under date of December 7, 1886, and printed in the Annual Report of the Chief of Engineers for 1887, Part I, page 639

In this report a project for improvement was proposed, which consisted in dredging a channel 8 feet deep at mean low water and 100 feet wide, to extend up the harbor, and to be about 6,000 feet long; the estimated cost was $25,000. This project was adopted in 1888, when work under it was ordered by the appropriation of $5,000 made by act of Congress of August 11, 1888.

Up to July 1, 1891, 22,938 cubic yards had been dredged under this project, making the channel about 1,500 feet long, 50 feet wide, and 8 feet deep at mean low water.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

At the beginning of the fiscal year a contract for dredging was in force, entered into with Mr. George B. Beardsley, under date of February 27, 1891, rate 14.6 cents per cubic yards, measured in scows.

Work under this contract was begun August 25, and completed October 9, 1891, the total amount dredged being 30,000 cubic yards. The previous dredged channel, 1,500 feet long, about 50 feet wide, and 8 feet deep at mean low water, was widened to 60 feet and extended about 950 feet to a point opposite Monsells Dock.

PRESENT CONDITION OF IMPROVEMENT.

Under the existing project the channel has been dredged from deep water in Long Island Sound about 2,450 feet up the harbor, with width of 60 feet and depth of 8 feet at mean low water. It retains its depth fairly well, the only shoaling being from a slight falling in of its banks.

PROPOSED OPERATIONS.

With future appropriations it is proposed to widen and extend the harbor channel, as contemplated by the project.

Appropriations for improving harbor at Five Mile River have been made as follows:

Application.	Date.	Amount.
Dredging	Aug. 11, 1888	$5,000
Do	Sept. 19, 1890	5,000
Total		10,000

Five Mile River is in the Fairfield collection district, and is about 13 miles west of Bridgeport, the port of entry.

The nearest light-house is on Sheffield Island, nearly 2 miles from the mouth of the harbor.

The nearest work of defense is Fort Schuyler, at the head of Long Island Sound, 27 miles southwest.

Money statement.

July 1, 1891, balance unexpended	$5,126.87
June 30, 1892, amount enpended during fiscal year	5,013.83
July 1, 1892, balance unexpended	113.04
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,113.04
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of contract for improving Five Mile River Harbor, Connecticut, in force during fiscal year ending June 30, 1892.

Name and address of contractor	Date of contract.	Subject.	Price per cubic yard.	Remarks.
George B. Beardsley, Bridgeport, Conn.	Feb. 27, 1891.	Dredging*	*Cents.* 14.6	Contract completed Oct. 9, 1891, 30,000 cubic yards dredged.

---

* Part of a contract for dredging in the harbors of Bridgeport, Black Rock, Five Mile River, and Norwalk.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1891.

Bushels of oysters raised		720,000
Value of oysters raised		$432,000
Steamers employed		25
Sail vessels employed		112
Draft of above vessels	feet	1½ to 8
Tonnage of above vessels	tons	2 to 175
Value of above vessels		$222,000

About 10,000 tons of coal were landed here during the year 1891, and this would be largely increased but for the delay in discharging because of shoal water.

No new lines of transportation have been established since July 1, 1891.

D 15.

IMPROVING STAMFORD HARBOR, CONNECTICUT.

This is a small harbor on the north shore of Long Island Sound, about 6 miles east of the New York State line. The harbor consists of a bay about a mile long and a mile broad, and of the mouth of the Mill River, a small stream which is dammed at Oliver Street Bridge, the head of the harbor. The original low-water depth for a mile below the bridge was from 1 to 3 feet in a crooked channel, and the 6-foot curve in the bay was about 6,600 feet below the bridge; the wharves are all in the upper half of this distance.

The mean rise of the tide is 7.9 feet.

PROJECTS FOR IMPROVEMENT.

By act of March 2, 1829, Congress appropriated $100 for making a survey of the harbor of Stamford, Conn., with a view to its improvement. The survey was made by Capt. Hartman Bache, U. S. Engineers, in 1829. In his report on the same, dated May 10, 1830, Capt. Bache recommended excavating the channel (proposing to build a steam dredge for the purpose), the cost being estimated as follows:

For a channel 12 feet deep at ordinary high water (about 4 feet at mean low water)	$13,250.00
For a channel 10 feet deep at ordinary high water	11,035.20

No money was appropriated for carrying out this plan.

The river and harbor act of 1882 authorized a survey of this harbor, which was made in the following year. In his report on this survey, dated December 12, 1883 (printed in Senate Ex. Doc. No. 50, Forty-eighth Congress, first session, also in annual report of the Chief of Engineers for 1884, Part I, page 672), Col. McFarland, U. S. Engineers, submitted a project for dredging a channel 80 feet wide and 5 feet deep at mean low water, from deep water in the bay up to Oliver Street Bridge, estimated to cost as follows:

Dredging, 80,000 cubic yards of mud, at 20 cents	$16,000
Contingencies	4,000
Total	20,000

It was not intended to include the removal of the ledge under and just below the bridge.

The beginning of the work under this project was approved by the

Secretary of War, August 30, 1886, after the first appropriation for improving the harbor had been made.

Up to July 1, 1891, the channel had been made 5 feet deep at mean low water and 80 feet wide up to within 1,000 feet of the head of the harbor, where the width was but 50 feet.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

The dredging under open market transaction which was suspended in June, 1891, was resumed November 17, 1891, and completed December 10, 1891; the total number of yards removed during the fiscal year was 7,365, making a total of 22,915 cubic yards under the appropriation of 1890.

Two bends in the upper part of the harbor were widened 20 feet on the west side for a distance of about 650 feet north from W. D. Smith's coal dock.

PRESENT CONDITION OF THE WORK.

The channel depth is now 5 feet at mean low water, and about 80 feet wide from deep water in the bay up to within 1,000 feet of the head of the harbor; near the head of the harbor the width is from 50 to 70 feet; at the bends the width has been made from 100 to 140 feet.

PROPOSED OPERATIONS.

The last appropriation completes the amount originally estimated for this project, and the project itself is practically completed. Small amounts will be required from time to time to maintain the channels.

Appropriations for improving Stamford Harbor have been made as follows:

Application.	Date.	Amount.
Survey	Mar. 2, 1829	$100
Do	Aug. 2, 1882	350
Dredging	Aug. 5, 1886	10,000
Do	Aug. 11, 1888	5,000
Do	Sept. 19, 1890	5,000
Total		20,450

Stamford Harbor is in the Fairfield collection district of which Bridgeport is the port of entry. There is a light-house on the Middle Ground at the harbor entrance. The nearest work of defense is Fort Schuyler, Throgs Neck, 20 miles to the southwest.

Money statement.

July 1, 1891, balance unexpended	$3,287.18
June 30, 1892, amount expended during fiscal year	3,226.45
July 1, 1892, balance unexpended	60.73
Amount appropriated by act approved July 13, 1892	15,000.00
Amount available for fiscal year ending June 30, 1893	15,060.73

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1891, NOT INCLUDING THAT VIA THE CANAL.

Arrivals and departure of vessels.

[Draft, 5 to 12 feet; tonnage, 10 to 375 tons.]

Kind of vessels.	No. of round trips.
Steamers	180
Sailing vessels	400
Barges	170
Total	750

Freight received and shipped.

	Tons.	Estimated value.
Coal	20,000	$100,000
Lumber and baryta	23,000	45,000
Miscellaneous	16,000	140,000
Total	59,000	285,000

No new lines of transportation have been established since July 1, 1891.

The above figures show an increase of freight tonnage of 9,000 tons over those reported for 1890.

COMMERCE OF THE EAST BRANCH (SOMETIMES CALLED THE CANAL).

Arrivals and departures of vessels.

[Draft, 5 to 12½ feet; tonnage, 50 to 543 tons.]

Steamers	502
Sailing vessels	75
Barges	160
Total	737

Freight received and shipped.

Articles.	Tons.	Value.
Coal	32,784	$137,236
Lumber and building materials	9,800	104,800
Miscellaneous	48,509	3,180,025
Total	91,093	3,422,061

No statistics have heretofore been received of the commerce of the East Branch.

No new steam lines of transportation have been established since July 1, 1891, but a somewhat regular communication has been inaugurated between the East Branch and Cold Spring, Long Island, by sailing vessels, which bring over produce, and which use the East Branch as being most convenient to the business center of the town. In the above figures no small boats or pleasure craft are included.

D 16.

IMPROVEMENT OF PORT CHESTER HARBOR, NEW YORK.

This harbor consists of the lower part of the Byram River and a bay at its mouth opening into Long Island Sound. The river for about 1½ miles from its mouth forms the boundary line between the States of New York and Connecticut. It was formerly navigable to within a few hundred feet or the bridge at Port Chester, a little more than a mile above the mouth.

Before improvement the available depth up to the wharves was about 1 foot at mean low water.

The mean rise of tide is 7.4 feet.

PROJECTS FOR IMPROVEMENT.

A survey of the harbor was made in 1871, and a project for improvement based on it was submitted and adopted. The project provided for the removal of two rocks—Sunken Rock, at the entrance to the bay, with 5.7 feet low-water depth, to be removed to 11 feet, and Salt Rock, about 1,000 feet above the mouth of the river, partly bare at low water, to be removed to 9 feet depth; it also provided for a breakwater, 400 feet long, at Byram Point. The estimated cost was as follows:

Sunken Rock, 1,474.5 cubic yards, at $40	$58,980
Salt Rock, 316.3 cubic yards, at $40	12,652
Breakwater at Byram Point	25,000
Total	96,632

Under this project Salt Rock was removed in 1873. No further work was done until 1884, when a survey of the channel was made under the appropriation of August 2, 1882, and a project for expending the funds available in 1884 (about $16,000) was submitted and approved. It provided for making a channel from 60 to 100 feet wide and 2½ feet deep at mean low water, from the bay to the vicinity of the bridge at Port Chester. The channel was completed to within 150 feet of the bridge in May, 1885.

In 1886 9,232 cubic yards of sand and gravel were dredged, straightening the channel and removing small lumps and irregularities. Under the appropriation of $5,000 made in 1888, the project was modified to omit the removal of Sunken Rock, and to change the location of the proposed breakwater, making it extend from Sunken Rock toward the shore. Sunken Rock was dangerous only because it was submerged, and was at the side of the channel; the channel width at the rock was ample. A breakwater with the end on the rock, rising some distance above high water, would serve as a beacon, and would be an aid instead of a danger to navigation, besides affording more shelter than the originally proposed breakwater; thus it would take the place both of the breakwater and of the removal of Sunken Rock, together estimated to cost $83,980. On account of this modification, in the Annual Report of the Chief of Engineers for 1890, the estimated cost of completion of project was reduced from $64,632 to $25,000.

Up to July 1, 1891, Salt Rock had been removed, a channel 2½ feet deep at mean low water had been dredged up to the Port Chester Highway Bridge, and 585 linear feet of breakwater had been constructed from Sunken Rock toward Byram Point.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

Nothing was done.

PRESENT CONDITION OF IMPROVEMENT.

Salt Rock has been removed to a depth of 9 feet at mean low water.

An available channel, 2½ feet deep at mean low water, has been dredged to a point 150 feet below the bridge; thence to the bridge, the width is 25 feet. In front of the wharves, where vessels lie aground at low tide, the bottom has been leveled as nearly as practicable.

Five hundred and eighty-five linear feet of the breakwater have been built with the top 5 feet wide, and 1 foot above high water, and with slopes of 1 upon 1; the end of the breakwater, resting upon Sunken Rock, was built to 5 feet above high water, to serve as a beacon.

PROPOSED OPERATIONS.

With future appropriations it is proposed to extend the breakwater to high-water mark on Byram Point, and to maintain, and, if necessary, to deepen the channel of the river.

The estimated cost of completion of the project is $20,000.

Appropriations for Port Chester Harbor have been made as follows:

Application.	Date.	Amount.
Removing Salt Rock	June 10, 1872	$12,000
Dredging in Byram River and Bay	Aug. 2, 1882	15,000
Breakwater	Aug. 11, 1888	5,000
Do	Sept. 19, 1890	5,000
Total		37,000

Port Chester Harbor is in the collection district of New York.

The nearest light-house is on Great Captain Island, 1¾ miles east of the mouth of the harbor.

The nearest work of defense is Fort Schuyler, Throgs Neck, about 15 miles southwest.

Money statement.

July 1, 1891, balance unexpended	$1,058.69
June 30, 1892, amount expended during the fiscal year	446.67
July 1, 1892, balance unexpended	612.02
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,612.02
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1891.

Arrivals and departures of vessels.

Draft, 5½ to 9 feet; tonnage, 25 to 300 tons.

	No. of round trips.	Tonnage.
Steamers	550	60,000
Sail vessels	400	22,000
Barges	600	125,000
Total	1,550	207,000

Freight received and shipped by water.

	Tons.	Estimated value.
Receipts	143,000	$1,100,000
Shipments	28,000	900,000
Total	171,000	2,000,000

The above figures show an increase in tonnage of freights since 1890 of 11,000 tons.

The principal articles of commerce by water are manufactured goods, coal, iron, farmers' produce, and general merchandise.

No new lines of transportation have been established since July 1, 1891.

D 17.

IMPROVEMENT OF LARCHMONT HARBOR, NEW YORK.

Larchmont Harbor is a bay on the northwest shore of Long Island Sound, about 25 miles by water from the Battery, New York City, and 6 miles southwest from the boundary between the States of New York and Connecticut. The harbor is about half a mile wide, and extends rather more than half a mile inland; it is a basin with no definite channel, the low-water depth of 18 feet at the entrance gradually decreasing towards the shores, east, north, and west.

The harbor is chiefly used by the Larchmont Yacht Club, but is more or less sought by small coasters and fishing vessels for refuge or for night anchorage. It is exposed to storms from east to south, and during northeast storms heavy seas roll around Long Beach Point, east of the harbor, and compel vessels to go well up into shoal water for shelter.

The entrance is divided into three channels by two rocks; Umbrella Rock, about 800 feet from the west shore, being a large ledge with least depth of 3.1 feet at mean low water, and Huron Rock about 900 feet southwest from the east shore, a smaller ledge with least depth of 9.8 feet. The channel between the rocks is over 900 feet wide, and is the one almost invariably used. There are other rocks inside the harbor which are well known and are marked by spindles; they are too near the west shore to interfere with the use of the harbor for general navigation.

The mean rise of tide is 7.4 feet.

PROJECTS FOR IMPROVEMENT.

The river and harbor act of August 11, 1888, provided for a survey of Larchmont Harbor, which was made the following year. The report on the survey, dated November 26, 1889, was printed as House Ex. Doc. No. 40, Fifty-first Congress, first session, and also in the Annual Report of the Chief of Engineers for 1890, Part I, page 675. With the report were presented two alternative projects for improvement; one for removal of Umbrella and Huron rocks, the other for breakwaters to cover each rock and extend to the nearest shore; the cost of removing the rocks to 15 feet depth at mean low water was estimated at $126,000, and the cost of the two breakwaters at $105,000. At the date of the report, the preference of those most interested in [illegible] harbor was expressed in favor of removing the rocks; after further consideration they changed their views, preferring the breakwaters, and in accordance with their petition or request, a clause in the first draft of the river and harbor act of 1890, which required that the money appropriated for this harbor be expended "to remove obstructions at mouth of harbor" was struck out.

The project for constructing two breakwaters at the mouth of the harbor was approved by the Secretary of War September 27, 1890, after the first appropriation for improving the harbor was made.

Up to July 1, 1891, 74 linear feet of Umbrella Breakwater and 64 linear feet of Huron Breakwater had been built.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

Nothing was done.

PRESENT CONDITION OF IMPROVEMENT.

The only public work done in this harbor is the beginning of construction of two breakwaters; Umbrella Breakwater has been made 74 feet long and Huron Breakwater 64 feet long. Both were begun upon the rocks and were built to 10 feet above low water, with top width of 4 feet, the outer ends being slightly higher to serve as beacons on the rocks. At their present lengths they serve no other purpose than to mark the rocks.

PROPOSED OPERATIONS.

Future appropriations should be applied to completing both breakwaters, as provided for in the project.

The only appropriation for improving Larchmont Harbor is the one of $5,000 made by act of Congress approved September 19, 1890.

Larchmont Harbor is in the collection district of New York. The nearest lighthouse is on Execution Rock, 3 miles southward. Fort Schuyler, about 8 miles southwest, is the nearest work of defense.

Money statement.

July 1, 1891, balance unexpended	$414.28
June 30, 1892, amount expended during fiscal year	293.33
July 1, 1892, balance unexpended	120.95
Amount (estimated) required for completion of existing project	100,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1891.

Number of yachts entering harbor during 1891 (estimated)		2,200
Draft of these yachts	feet	3 to 13
Tonnage of these yachts	tons	3 to 400
Number of vessels other than yachts entering harbor for refuge or for night during 1891 (estimated)		250
Draft of such vessels	feet	4 to 10
Tonnage of such vessels	tons	10 to 300

Freight discharged in Larchmont Harbor in 1891.

Number of cargoes	30
Amount in tons	2,000

Vessels owned by Larchmont Yacht Club.

[Draft, from 3 to 13 feet; tonnage, 6 to 300 tons; total tonnage, 5,000 tons.]

Steamers	43
Schooners	38
Sloops	86
Smaller boats	87
Total	254

No new lines of transportation have been established since July 1, 1891.

D 18.

IMPROVEMENT OF ECHO HARBOR, NEW ROCHELLE, NEW YORK.

Echo Harbor is a bay on the north shore of Long Island Sound, distant about 24 miles by water from the battery at New York. It is landlocked except towards the southeast and has a good anchorage. Nearly all of the water transportation of the town of New Rochelle is carried on through this harbor.

The depth in the bay varies from 6 to 15 feet at mean low water, though the low-water channel up to the wharves is only from 1 to 2 feet deep.

The mean rise of tide is 7.3 feet.

PROJECT FOR IMPROVEMENT.

A survey was made in 1875 and a project based on it was submitted December 20, 1875, and subsequently adopted, providing for the removal of two rocky reefs from the channel, viz:

First. Sheepshead Reef, lying midway between Echo Island and Duck Point, which had 1.6 feet of water upon it at low tide. This was to be removed to a depth of 9 feet at low water, which required the excavation of 872.5 cubic yards of rock, costing	$21,201.75
Second. Start Rock, which projects about 2 feet above low water, and lies in the channel 120 feet from Beaufort Point. This was to be removed to 7 feet below low water, requiring the excavation of 370 cubic yards of rock, costing	12,672.50
Contingencies	5,081,13
Total	38,965.38

A depth of 7 feet over Start Rock was obtained in January, 1880, and in 1881–1883 506 cubic yards were removed from the southern part of Sheepshead Reef, making 9 feet depth. In May, 1889, a petition of residents of New Rochelle was submitted, asking that the money then available be expended in dredging up to the wharves. This was approved by the Chief of Engineers and the money was expended in making a channel 40 feet wide and 4 feet deep at mean low water, extending from the bay to within 300 feet of the head of the harbor, a distance of about 1,050 feet.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

The available funds were insufficient to continue the improvement, and no work was done.

PRESENT CONDITION OF IMPROVEMENT.

Start Rock has been removed to 7 feet depth at mean low water and about one-half of Sheepshead Reef has been removed to a depth of 9 feet at mean low water.

The channel, dredged 4 feet deep and 40 feet wide in 1889, has filled somewhat, but is still used by vessels going to the upper wharves.

PROPOSED OPERATIONS.

To complete the project there yet remains the removal of the rest of Sheepshead Reef, which can be done with the balance of the original estimate not yet appropriated, $17,000, provided it be available at one time, and it is recommended, on the ground of economical expenditure, that, if further appropriations be made for removal of rocks in this harbor, not less than the estimated sum required be appropriated.

Appropriations for improving Echo Harbor, New Rochelle, New York, have been made as follows:

Application.	Date.	Amount.
Removal of Start Rock	June 18, 1878	$10,000
Do	Mar. 3, 1879	3,000
Removal of Sheepshead Rock	June 14, 1880	3,000
Do	Mar. 3, 1881	3,000
Dredging	Aug. 2, 1882	3,000
Total		22,000

Echo Harbor is in the collection district of New York.

The nearest light-house is on Execution Rock.

The fortifications on Throgs Neck, 7 miles to the westward, are the nearest works of defense.

Money statement.

Amount (estimated) required for completion of existing project	$17,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	17,000.00

Submitted in compliance with reqirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1891.

No statistics for the calendar year 1891 have been received. The number of tons of freight reported received for 1890 is probably a fair annual average, 90,000 tons.

D 19.

IMPROVEMENT OF EAST CHESTER CREEK, NEW YORK.

East Chester Creek, called also Hutchinson River, is a small stream which, as a tidal inlet for the last 4 miles of its course, traverses marshes of one-quarter to a mile in width and empties into East Chester or Pelham Bay, a large bay on the northwest shore of Long Island Sound, just east of Throgs Neck and 20 miles by water from the Battery, New York City. The width of the creek varies from 25 feet to a half mile at high water, but the channel is narrow everywhere.

Pelham Bridge, a highway bridge, crosses the creek near its mouth. A short distance above is the bridge and trestle of the Harlem River branch of the New York, New Haven and Hartford Railroad, and at Lockwood, about 2¼ miles above its mouth, the stream is crossed by the Boston road. All three bridges are drawbridges.

The mean rise of tide at the mouth of the creek is 7.1 feet.

For half a mile up the creek there was originally a channel from 4 to 9 feet deep at low water, but the depth decreased farther up, and at Town Dock, the principal landing, about 1½ miles from the mouth, the available depth at high water was only about equal to the rise of the tide. Above Town Dock, the stream was narrow and crooked, and the depth about the same as just below.

The commerce at Town Dock was principally in coal and building materials for East Chester and Mount Vernon; the latter is a rapidly growing place with a present population of about 14,000. The main part of the city of Mount Vernon is about 2 miles from Town Dock. It is understood to be mainly for the benefit of prospective Mount Vernon commerce that the improvement of East Chester Creek is desired.

PROJECTS FOR IMPROVEMENT.

In 1871 a survey of East Chester Creek was ordered by Congress. It was made in the same year, and in the report, dated January 19, 1872, and printed in the Annual Report of the Chief of Engineers for 1872, page 812, three plans of improvement were outlined, viz:

For making and maintaining by means of a tidal basin and a system of dikes a channel 9 feet deep at mean low water, estimated to cost $1,646,000.

For making and maintaining in the same way a channel 11 feet deep at mean high water (about 4 feet deep at low water) estimated to cost $731,000.

For securing 7 feet depth at slack-water navigation by means of a lock above Goose Island (about half a mile from the mouth of the creek), estimated to cost $300,000.

No recommendation as to the worthiness of improvement accompanied these estimates. March 25, 1872, the House of Repsesentatives passed a resolution inquiring the cost of removing obstructions between tide-gauges No. 1 and No. 2, so as "to afford the same depth of water above station No. 1 as now prevails below it."

In reply to this resolution a report was submitted April 3, 1872, (see Annual Report of Chief of Engineers for 1872, page 814) containing the following estimates:

Basin, purchase of site, 18 acres, at $150	$2 700
Excavation to level of mean low water, 200,000 cubic yards, at 40 cents	80 000
Excavation of cut, 60,000 cubic yards, at 40 cents	24,000
Diking and revetting banks of cut	12,000
Engineering and contingencies	17,805
Total	136,505

This plan contemplated (as appears from maps on file) straightening the channel at Lockwood and, as it was necessary in any case to replace the old arch bridge of the Boston road by a drawbridge, changing the location of such bridge to a point about 700 feet eastward, so as to give a straighter and cheaper channel for the stream.

In 1873, $25,000 was appropriated for improving East Chester Creek. It was designed to expend it in accordance with the above estimates, which were then considered an adopted project, but no means had been provided for acquiring the land needed for the proposed cut at Lockwoods, so no work was done at that time.

In 1875 it became apparent that the proposed change of location of the drawbridge at Lockwood could not be made. The old bridge lay on the boundary between the towns of East Chester and Pelham and was supported by the towns jointly. Under the proposed change of location the new bridge would lie within the town of Pelham, which town would then have to support it; therefore the town of Pelham would not consent to the change and the old bridge was replaced by an iron drawbridge in the same location. The proposed location of the cut had, therefore, to be altered to bring it to the drawbridge. This necessitated excavating a considerable amount of rock at an increased cost of $10,000. (See Gen. Newton's letter to the Chief of Engineers, September 24, 1875.)

In 1875 $12,000 more was appropriated for this improvement, but it it was not until 1877 that a commission, appointed by the State of New York, finally obtained the land for the proposed cut. After this right of way was secured, in 1877, a contract was entered into for making a cut 9 feet deep at mean high water (2 feet at low water), with a width of 100 feet at high-water level; this contract included about 3,149 cubic yards of rock excavation, 1,210 linear feet of pile dike, and 140 linear feet of crib dike. It was completed in 1878, and in that year and in 1879, under an appropriation of $10,000 made June 18, 1878, dredging was done by hired labor, removing a shoal of bowlders just outside of Pelham bridge and making a channel about 125 feet wide and 9 feet deep at high water on the west side of Goose Island, being an extension of the original project.

In 1879 $3,500 was appropriated for continuing the improvement, and $3,500 in 1880; these appropriations were not expended until 1884.

In the Annual Report for 1879 it was stated as necessary, to complete the improvement from Pelham Bridge to Lockwood, "to construct dikes from the lower end of the cut to Goose Island, a distance of 5,800 feet." In 1880 these dikes were estimated to cost $40,000.

The appropriations were not large enough to warrant beginning the cut above Lockwood or the above-mentioned dikes, and these proposed works were apparently abandoned for the time being. In 1881 Gen. Newton, U. S. Engineers, then in charge, reported that "furthermore, until it is proved that a depth of 9 or 10 feet * * * can not be maintained under the scale of improvement already completed, it will be unnecessary to inaugurate new works. The amount of funds available, $7,372.14, will be quite sufficient for the present wants of the case."

This money was expended in 1884 in dredging just below Town Dock, a work not included in the original estimate.

August 5, 1886, $10,000 were appropriated for this improvement, which was mostly expended, in 1888 and 1889, in dredging between Town Dock and Lockwood, to remove shoals from the previously dredged channel.

In 1887 an estimate was made of the cost of the several proposed extensions of project, from which it appears that $84,000 have been either expended or estimated for works not included in the first estimate, and that estimate, therefore, should be increased to $221,000 if it is proposed to carry out the original plan with these extensions.

It was proposed to expend the appropriation of $5,000 made August 11, 1888, in dredging a cut above Lockwood, and in January, 1889, the line of cut was staked out and a description given to the State commissioners for securing right of way. They were asked to obtain permission to deposit the material on the marsh lands adjacent to the cut, which could be done cheaply as compared with the cost of carrying it out into Long Island Sound. The commissioners reported that this consent could not then be obtained, and, as the available funds were not sufficient to begin work under any other plan for disposing of dredged materials, work was postponed until larger appropriations should be made.

Up to July 1, 1891, no work had been done above Lockwood; the channel below Lockwood had an available depth of 9 feet at mean high water, with widths from 50 to 125 feet, and was used by such commerce and freight as could be conveniently discharged at Town Dock and at Lockwood.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

No work of improvement was done. Right of way for the channel above Lockwood and consent to deposit dredgings upon adjacent banks have been tendered by the owners of the land.

The local authorities in charge of the drawbridge at Lockwood have begun repairs necessary in order to open the draw.

PRESENT CONDITION OF IMPROVEMENT.

There is a channel of not less than 9 feet depth at mean high water (2 feet at low water) from the bay up to Lockwood, being about 100 feet wide up to a point 1,000 feet above Town Dock, thence to Lockwood from 50 to 75 feet wide. The dikes on the east side of the channel near Lockwood are in fair condition.

The cut above Lockwood has not been begun.

PROPOSED OPERATIONS.

As soon as the drawbridge at Lockwood is put in working order it is proposed to apply the available funds to beginning the projected cut above Lockwood; it is estimated that the cut can be made about one-third its contemplated length.

The proposed dikes below Town Dock do not seem to be necessary at present as a means of improving or maintaining the channel. The work remaining to be done under the project is the excavation of the cut above Lockwood and small repairs and maintenance of the previously dredged channel below Lockwood, for which revised estimates amounting to $55,000 were submitted in the annual report for 1891.

Appropriations for improving East Chester Creek have been made, as follows:

Application.	Date.	Amount.
Cutting through marsh and rock and diking (in 1877)	Mar. 3, 1873	$25,000
Dredging under Boston Road Bridge and at Goose Island	Mar. 3, 1875	12,000
Dredging near Lockwood, Goose Island, and Pelham Bridge	June 18, 1878	10,000
Dredging from 40 to 90 feet wide from Pell Point to Town Dock	Mar. 3, 1879	3,500
	June 14, 1880	3,500
Dredging above Town Dock (not wholly expended)	Aug. 5, 1886	10,000
Not yet expended	Aug. 11, 1888	5,000
Total		69,000

East Chester Creek is in the collection district of New York.

The nearest light-house is on the "Stepping Stones," 3 miles southeast of the mouth of the creek.

The nearest work of defense is Fort Schuyler, Throg Neck, about 3½ miles south.

Money statement.

July 1, 1891, balance unexpended	$7,141.03
July 1, 1892, balance unexpended	7,141.03
Amount (estimated) required for completion of existing project	55,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	55,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1891.

Arrivals and departures of vessels.

Schooners	22
Sloops	9
Barges	193
Total	224

Freight received and shipped.

	Tons.
Lumber	7,240
Building material	380
Stone	16,310
Water pipe (iron)	900
Coal	13,285
Ice	9,000
Total	47,115

The above figures show an increase in tonnage over that reported for 1890 of 27,610.

No new lines of transportation have been established since July 1, 1891.

D 20.

IMPROVEMENT OF GREENPORT HARBOR, NEW YORK.

This harbor is a roadstead near the east end of the north fork of Long Island, lying between the north fork on the northwest and north and Shelter Island on the southeast and south. The anchorage ground is exposed to storms from the northeast and east.

A sand spit, called Joshua Point, formerly protected the little bay at Greenport from easterly storms, but in a few years prior to 1883 this had worn away rapidly and the sand had been carried into the bay.

The mean raise of tide is 2.4 feet.

PROJECT FOR IMPROVEMENT.

The river and harbor act for 1881 ordered a survey of this harbor, the report upon which, dated January 20, 1882, and printed in the Annual Report of the Chief of Engineers for 1882, Part I, page 635, contained plans and estimates for a breakwater (extending to the curve of 18 feet depth) to be built to 3 feet above mean high-water level, with a top width of 5 feet and side slopes of 1 upon 1; the estimated cost was $46,000. The first appropriation for the harbor was made by act of Congress of August 2, 1882, and thereupon the project was adopted as above. In 1890, the project was modified to provide for building up the breakwater to a height of 5 feet above mean high water, to extend it no further (it was then 1,570 feet long), and to apply the remainder of the estimate for completion of improvement to dredging in the anchorage afforded by the breakwater.

Up to July 1, 1891, about 909 linear feet of the breakwater had been built up as required under a contract in progress and arrangements had been made for dredging to increase the area of the anchorage basin of 9 feet depth.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1882.

During the past fiscal year 594 tons of stone were delivered and placed on the top of the breakwater, building it up to a height of 5 feet above mean high water for the remaining 661 feet of its length. The contract was completed August 26, 1891, 1,114 tons of granite having been delivered and placed as required.

Offers for dredging had been invited by circular letter and the proposal of the Hartford Dredging Company to do the required work at the rate of 18 cents per cubic yard had been accepted. Dredging was begun September 10 and completed October 29, 1891; 12,037 cubic yards being removed, enlarging the area of 9 feet depth inside the breakwater by about 1½ acres and dredging a channel 40 feet wide and 6 feet deep at mean low water, to afford entrance to Sterling Basin, a locality much used for winter anchorage on account of its complete shelter and soft bottom.

PRESENT CONDITION OF IMPROVEMENT.

The breakwater is now 1,570 feet long, 5 feet wide on top, the top being 5 feet above high water; it contains 19,310 tons of stone.

The available anchorage of 9 feet depth has been increased by 1½ acres of completely sheltered area, and a channel 40 feet wide and 6 feet deep exists between the outer harbor and Sterling Basin, where there is completely landlocked anchorage of about 4 acres, with 3 feet depth or over at mean low water.

PROPOSED OPERATIONS.

Future appropriations will be applied to enlarging the anchorage basin by dredging as provided in the modified project.

Appropriations for improving Greenport Harbor have been made as follows:

Application.	Date.	Amount.
Survey	Mar. 3, 1881	500
Expended on breakwater	Aug. 2, 1882	10,000
Do	July 5, 1884	10,000
Do	Aug. 5, 1886	5,000
Do	Aug. 11, 1888	5,000
Breakwater and dredging	Sept. 19, 1890	5,000
Total		35,500

Greenport is a port of delivery in the collection district of Sag Harbor.

The nearest light-house is on Long Beach Point, 3 miles to the eastward.

The nearest work of defense is Fort Trumbull, New London Harbor, Connecticut, 21 miles distant in a straight line.

Money statement.

July 1, 1891, balance unexpended	$4,505.85
June 30, 1892, amount expended during fiscal year	4,312.94
July 1, 1892, balance unexpended	192.91
Amount appropriated by act approved July 13, 1892	11,000.00
Amount available for fiscal year ending June 30, 1893	11,192.91

Abstracts of contracts for improving harbor at Greenport, New York, in force during the fiscal year ending June 30, 1892.

Name and address of contractors.	Subject of contract.	Price per ton.	Price per cubic yard.	Remarks.
Brown & Fleming, New York City.	Delivering riprap granite and building up breakwater.	$1.29		Contract completed Aug. 19, 1891. Total amount 1,114 tons granite.
Hartford Dredging Company, Hartford, Conn.	Dredging		$0.18	Contract completed Oct. 29, 1891, 12,037 cubic yards.

Commercial statistics for the calendar year 1891 for Greenport Harbor have been asked for and have not been received.

D 21.

IMPROVEMENT OF PORT JEFFERSON HARBOR, NEW YORK.

Port Jefferson Harbor is on the north shore of Long Island and about 50 miles east from New York City. It is a mile long and averages three-quarters of a mile wide, and a large part of the area has a depth of 18 feet or more at low tide. Tributary to this harbor, on the west, are Setauket Harbor and Conscience Bay, two shallow tidal basins. Port Jefferson Harbor is surrounded on three sides by hills and is separated from Long Island Sound on the north by a beach of sand and gravel, through which, and nearly in the axis of the harbor, is a single entrance 400 feet wide. This entrance is Port Jefferson Inlet, and through it a tidal reservoir of 2 square miles area receives and discharges some 300,000,000 cubic feet of water with every tide, producing a current whose maximum velocity exceeds 4 miles per hour. In the narrow part of the inlet the depths have always been considerable, but a short distance out into the Sound was a broad flat bar, which originally had a depth of 4 feet at low water; until the beginning of Government improvement in 1871, the location of the inlet had been shifting; since 1838 it had moved westward 790 feet, an average annual rate of 24 feet.

The village of Port Jefferson, with a population of about 3,000, lies at the head or south end of the harbor. The mean rise of tides at the village wharves is 6.2 feet; in Long Island Sound, outside the inlet, it is 7 feet. The difference is wholly in the low-water levels.

PROJECTS FOR IMPROVEMENT.

A survey of the harbor was made in 1853 by Lieut. Harrison, U. S. Engineers. In 1870 an examination was ordered by Congress. The first project of improvement was submitted by Gen. Warren, January 16, 1871, after an examination, and provided for building a jetty on the east side of the entrance, extending out to the 9-foot curve and rising to 11 feet above mean low water, to be built partly of dimension stone; also for dredging a channel 200 feet wide and 7 feet deep at mean low water through the bar. (See annual report of the Chief of Engineers for 1871, page 805.) The estimated cost was as follows:

Construction of jetty	$150,125
Dredging	15,000
Total	165,125

When the project was adopted under the appropriation of March 3, 1871, it was provided that the jetty should be of riprap, rising only to the level of mean high water, except between the high and low water marks on the beach, where it was to be carried to the level of the highest tides; but no change was made in the estimates. Under this appropriation 600 feet of the jetty were built and under the appropriation of June 10, 1872, it was extended to 1,052 feet. An estimate made in 1873 of the cost of completion ($35,000) made the estimate for the whole project $65,000. In 1875 a modification of the project based on the observed effect of the jetty, was made, providing for a jetty on the west side of the entrance, about 1,075 feet long and rising 4 feet above mean high water, designed to increase the force of the tidal currents. The width of the channel was also reduced to 100 feet. No new estimate was submitted at the time, but in 1877, after about $8,000 had been expended on the west jetty, it was estimated that $12,250 would be required to complete it, or $20,250 in all. A revised estimate, made in the same year for the whole improvement, contemplated extending the east jetty to the 9-foot curve, extending the west jetty 600 feet farther, and dredging a channel 100 feet wide and 8 feet deep (this increase of depth on account of increased draft of vessels using the harbor), at an estimated cost of $34,000; $45,000 had then been appropriated and nearly expended, making the total estimate from the beginning $79,000 (including $6,000 appropriated in 1876 and then unexpended). This estimate was incorrectly reported in 1878, but was reverted to in 1879 and repeated in each subsequent annual report. In 1877 one cut 25 feet wide and 8 feet deep was dredged through the bar. The channel was dredged to a width of 100 feet under the appropriation of March 3, 1879. In 1877 the east jetty was raised to a height of 5 feet above mean high water and extended 50 feet. In 1878 the west jetty was extended 450 feet, but the height was made only 2 feet above mean low water, except the outer end and an intermediate point, which were raised to 4 feet above mean high water, to serve as guides.

Between 1879 and 1883 both jetties were extended and repaired, making their respective lengths 1,390 feet for the east jetty and 940 feet for the west jetty. This completed the then existing project.

By act of Congress of August 11, 1888, an examination of Port Jefferson Inlet was ordered. A preliminary examination was found sufficient with recent Coast Survey charts for all required purposes, and with the report on this examination, dated December 5, 1888, and printed in the Annual Report of the Chief of Engineers for 1889 (Part I, page 751), were presented plans and estimates for making and maintaining channels through the inlet of 10 and 12 feet depth, respectively. The 10-foot channel was considered by interested parties as sufficient for present needs. The estimates in detail were as follows:

For a channel 10 feet deep and 200 feet wide—	
Repairing and enlarging east jetty	$34,200
Repairing and enlarging west jetty	18,150
Dredging	25,390
Contingencies, say	12,260
Total	90,000

Commencement of work under this project for 10 feet depth was approved by the Secretary of War November 1, 1890, after an appropriation had been made for "the project to give a channel 10 feet deep and 200 feet wide."

Up to July 1, 1891, 1,464 tons of riprap granite had been delivered in the east jetty, partly completing the work of enlargement over a distance of about 600 feet, under a contract then in progress.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

Under contract of February 3, 1891, with Humphrey Toomey, during the past fiscal year 7,520 tons of riprap granite were delivered and placed in the jetties, completing the enlargement of the east jetty for its whole length outside high-water mark (about 950 feet) and making it 6 feet above high water with a top width of 4 feet, and enlarging the west jetty to 4 feet above high water and 4 feet top width for about 250 feet of its outer part. The total amount of stone delivered under the contract was 8,984 tons. The contract was completed September 25, 1891.

After due advertisement, proposals for dredging were received to dredge through the inlet, about 2,000 feet long, making a depth of 10 feet at mean low water and width of 100 feet, more or less, depending upon the price of the work. Under date of March 8, 1892, a contract was entered into with Richard Parrott to do the above-mentioned work at the rate of 21½ cents per cubic yard, measured in scows. Work under this contract was begun May 31, and at the close of the fiscal year 2,285 cubic yards had been dredged, making the required depth over a part of the channel about 600 feet long and 20 feet wide.

PRESENT CONDITION OF IMPROVEMENT.

The east jetty is 1,390 feet long, part of the shore end being covered by drifted sand; it is 6 feet above high-water level and 4 feet wide on top. The west jetty is 940 feet long; the outer 250 feet are built up about 4 feet above high water, with top width of 4 feet; the inner part is about 2 feet above low water. The west jetty requires building up, and both require trimming and filling out the side slopes before they can fairly be considered completed.

The dredging of the past year is not sufficient to increase the available depth in the inlet, which remains about 8 feet.

PROPOSED OPERATIONS.

With the remainder of the appropriation of 1890 and under contract now in progress, it is proposed to make the inlet channel 10 feet deep at mean low water, with width of about 100 feet.

Future appropriations will be applied to completing the work provided for in the project.

Appropriations for Port Jefferson Harbor have been made as follows:

Application.	Date.	Amount.
East jetty	Mar. 3, 1871	$15,000
Do	June 10, 1872	15,000
East and west jetties	Mar. 3, 1875	15,000
East jetty and dredging	Aug. 14, 1876	6,000
East and west jetties	June 18, 1878	8,000
Dredging	Mar. 3, 1879	5,000
East and west jetties	June 14, 1880	3,000
East jetty	Mar. 3, 1881	4,000
Do	Aug. 2, 1882	8,000
Enlarging jetties and dredging	Sept. 19, 1890	25,000
Total		104,000

Port Jefferson is a port of delivery in the collection district of New York.

There is a light-house on Old Field Point, 1½ miles west of the harbor entrance.

Fort Hale, New Haven Harbor, Conn., 23 miles distant, is the nearest work of defense.

Money statement.

July 1, 1891, balance unexpended		$25,047.89
June 30, 1892, amount expended during fiscal year		14,949.11
July 1, 1892, balance unexpended		10,098.78
July 1, 1892, outstanding liabilities	$591.27	
July 1, 1892, amount covered by uncompleted contracts	8,108.73	
		8,700.00
July 1, 1892, balance available		1,398.78
Amount appropriated by act approved July 13, 1892		10,000.00
Amount available for fiscal year ending June 30, 1893		11,398.78
Amount (estimated) required for completion of existing project		55,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		35,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging at Port Jefferson Inlet, N. Y., opened by Col. D. C. Houston, Corps of Engineers, February 25, 1892.

No.	Name and address of bidders.	Price per cubic yard (30,000 cubic yards).	Amount of bid.	Remarks.
1	The Hartford Dredging Co., Hartford, Conn.	$0.35	$10,500	
2	Elijah Brainard, New York City	.54	16,200	
3	Richard Parrott, Newburg, N. Y.*	.21½	6,450	Lowest bid.

*Lowest bid; entered into contract March 8, 1892; in progress.

NOTE.—Amount available for contract work, about $9,000.

Abstract of contracts for improving harbor at Port Jefferson, N. Y., in force during the fiscal year ending June 30, 1892.

Name and address of contractor.	Date of contract.	Subject.	Price.	Remarks.
Humphrey Toomey, Guilford, Conn.	Feb. 3, 1891	Delivering riprap and enlarging jetties.	$1.50 per ton..	Contract completed Sept. 25, 1891, 8,984 tons.
Richard Parrott, Newburg, N. Y.	Mar. 8, 1892	Dredging.........	0.21½ per cubic yard.	In progress.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1891.

Arrivals and departures of vessels.

[Draft, from 4 to 13 feet; tonnage, 15 to 577 tons.]

Kind of vessels.	No. of round trips.	Tonnage.
Steamers	540	47,620
Sail vessels	786	34,997
Barges	18	2,196
Total	1,344	84,813

Freight received and shipped by water.

	Tons.	Estimated value.
Receipts	33,925	$1,090,000
Shipments	8,400	120,000
Total	42,325	1,210,000

Number of vessels entered harbor for refuge	350
Number of vessels hauled up for repairs	209
Tonnage of vessels hauled up for repairs	13,298
Number of vessels laid up for winter 1891-'92	57
Tonnage of vessels laid up for winter 1891-'92	3,505

No new lines of transportation have been established since July 1, 1891.

D 22.

IMPROVEMENT OF HUNTINGTON HARBOR, NEW YORK.

Huntington Harbor is a landlocked basin about 2 miles long and a quarter of a mile wide, extending in a crooked but generally southern direction from Huntington Bay, from which it is separated by a beach of sand and gravel, through the western end of which a narrow inlet (about 300 feet wide) connects the harbor and bay.

The bay is a large, deep harbor of refuge on the north shore of Long Island, about 40 miles east from New York City. The harbor has an available depth of about 8 feet at mean low water through the entrance and more than half way up, but in the three-quarters of a mile nearest the head or south end of the harbor the original channel was narrow and decreasing in depth to zero at low tide.

Huntington village lies about a mile south of the head of the harbor; it has 4,000 to 5,000 population.

The mean rise of tide is 7.2 feet.

PROJECTS FOR IMPROVEMENT.

By act of Congress approved March 3, 1871, a survey of this harbor was authorized. It was made in that year, and, with the report, dated December 11, 1871, and printed in the Annual Report of the Chief of Engineers for 1872, page 907, was submitted an estimate of $22,780 as the cost of dredging out a shoal at the entrance to the harbor and of extending the 8-foot channel 150 feet wide for about 2,000 feet, up to the old wharf, the property of the town.

By act of Congress of June 10, 1872, $22,500 were appropriated for the harbor and the project for improvement was completed in April, 1873, the outer shoal being removed to 8 feet depth and the 8-foot channel being extended 2,200 feet, to the Old Town Wharf; the width of 150 feet was, however, reduced to 130 in the last 900 feet length on account of exhaustion of funds. It had been contemplated to dump most of the dredged material in the flats in the harbor, but on account of much local opposition this was abandoned after about 2,000 yards had been dumped there, and the rest of the dredged material was deposited in deep water in Long Island Sound. The amount dredged was 91,786 cubic yards.

The river and harbor act of July 5, 1884, ordered a survey or examination of this harbor. A survey was made the same year, the report on which (printed in the Annual Report of the Chief of Engineers for 1885, Part I, pages 703 *et seq.*) contains a plan for restoring and maintaining the depth of 8 feet, made by dredging in 1872 and 1873, but subsequently lost by settling of the banks, with estimate of cost for carrying the channel up to the Old Town Dock, as follows:

Dredging 84,000 cubic yards, at 25 cents per cubic yard	$21,000
Pile protection, 1,400 linear feet, at 5 cents per linear foot	7,000
	28,000
Superintendence and contingencies	4,000
Total	32,000

with an estimate of additional cost of $10,000, should it be decided to carry the channel up to the last wharf on the east side, a distance of 800 feet farther.

The beginning of work under this project was approved by the Secretary of War, November 3, 1890, after an appropriation for the improvement had been made by Congress.

July 1, 1891, a contract for dredging had been entered into, but work had not been begun.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

Under contract with Charles and Henry E. Du Bois, dated March 23, 1891, for dredging at the rate of $15\frac{9}{10}$ cents per cubic yard, work was begun September 30, 1891, and the contract was completed April 13, 1892, 55,137 cubic yards of mud and sand being dredged. A channel 8 feet deep at mean low water and 90 feet wide was dredged from deep water up to within 60 feet of Carlls Wharf, the upper landing in the harbor, a total distance of 2,900 feet; at a bend in the channel the width for 400 feet was increased to 120 feet.

PRESENT CONDITION OF IMPROVEMENT.

The channel, dredged in 1872–'73, was nearly obliterated, and the present condition of the channel is practically as above described, very slight subsidence and filling at the sides having occurred from the beginning of work up to the close of the fiscal year.

PROPOSED OPERATIONS.

It is proposed to apply future appropriations to completing the channel and to maintaining it by dredging or diking, as appears expedient.

Appropriations for improving Huntington Harbor have been made as follows:

Application.	Date.	Amount.
Dredging	June 10, 1872	$22,500
Do	Sept. 19, 1890	10,000
Total		32,500

Huntington Harbor is in the New York collection district.

The nearest light-house is on Eaton Point, at the east side of the mouth of Huntington Bay, about 4 miles distant from the harbor.

The nearest works of defense are the fortifications at Willets Point, about 20 miles westward.

Money statement.

July 1, 1891, balance unexpended	$9,895.60
June 30, 1892, amount expended during fiscal year	9,486.39
July 1, 1892, balance unexpended	409.21
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,409.21
Amount (estimated) required for completion of existing project	17,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	17,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of contract for dredging in Huntington Harbor, New York, in force during the fiscal year ending June 30, 1892.

Name and address of contractor.	Date of contract.	Subject.	Price per cubic yard.	Remarks.
			Cents.	
Charles and Henry E. Du Bois, New York City.	Mar. 23, 1891	Dredging	$15\frac{9}{10}$	Contract completed April 13, 1892, 55,137 cubic yards.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR, 1891.

Arrivals and departures of vessels.

[Draft, 5 to 8 feet; tonnage, 70 to 300 tons.]

Kind of vessel.	No. of round trips.	Tonnage.
Steamers	175	200
Sailing vessels	420	90
Barges	12	225
Total	607	515

Freight received and shipped by water.

	Tons.	Estimated value.
Receipts	30,000	$600,000
Shipments	13,000	270,000
Total	43,000	870,000

One new line of transportation has been established since July 1, 1891, and the freight rates to and from New York are reduced as the result of the recent improvement of channel.

D 23.

IMPROVEMENT OF GLEN COVE HARBOR, NEW YORK.

Glen Cove Harbor is a small estuary or creek opening into the east side of Hempstead Bay, Long Island, about 1¾ miles from Long Island Sound, and about 27 miles by water from the Battery, New York City. The channel in the creek is about 2 feet deep at mean low water, and a bar at the entrance has a foot less depth. Vessels entering Glen Cove Harbor have to wait for high tide, anchoring in Hempstead Bay, where they are exposed to storms from the north and northwest. When such storms are heavy, it is impossible to tow over the bar, and from this cause vessels have been obliged to remain in the bay for three or four days exposed to heavy seas.

The mean rise of tide in this harbor is 7.7 feet.

PROJECT FOR IMPROVEMENT.

The act of Congress, approved August 5, 1886, provided for a survey or examination of Glen Cove Harbor. A preliminary examination was all that was deemed necessary, and upon this, with the assistance of the United States Coast Survey charts, recently published, a report with estimates of cost of improvements was presented, dated December 7, 1886, and printed in the Annual Report of the Chief of Engineers for 1887, part 1, page 645.

The plan of improvement described in this report contemplated a breakwater about 2,500 feet long, and extending in a general westerly direction from Mosquito Point on the east side of Hempstead Bay and north of the entrance to Glen Cove Inlet, the breakwater to be built of riprap, the top to be 5 feet wide and 3 feet above high water, with side slopes of 1 upon 1, at an estimated cost as follows:

136,000 tons of riprap, at $1.35 per ton	$183,600
Contingencies, 10 per cent	18,360
Total	201,960

This project was adopted in 1888, an appropriation being made by Congress for beginning the work, and the location of the shore end of the breakwater was definitely fixed to be at the northwest corner of the Glen Cove Dock, and its course to be west southwesterly toward Mott Point.

Up to July 1, 1891, 824 linear feet of the breakwater had been built, and a contract for further extension was in progress.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

At the beginning of the year work was in progress under the contract, entered into December 29, 1890, with John A. Bouker, for extending the breakwater by delivering and placing riprap gneiss at the rate of 80 cents per cubic yard. During the year 13,220 cubic yards of riprap were placed, and the breakwater was extended 232 linear feet; the contract was completed December 9, 1891. The total amount of stone delivered under this contract was 16,244 cubic yards, about 24,366 tons, extending the breakwater 291 linear feet.

PRESENT CONDITION OF IMPROVEMENT.

The breakwater is now 1,056 feet long and 3 feet wide on top, rising to 1 foot above high water; it contains about 44,202 tons of riprap. The work is in good condition.

In order to build a greater length of breakwater with the money appropriated, and to secure some effective shelter at once, the work has not been built up to full dimensions; it will probably require enlarging.

PROPOSED OPERATIONS.

With future appropriations it is proposed to extend the breakwater, and to enlarge it to the cross section provided for in the project, if necessary. Fifty thousand dollars can be profitably expended for this purpose during the next fiscal year.

Appropriations for improving harbor at Glen Cove have been made as follows:

Application.	Date.	Amount.
Breakwater	Aug. 11, 1888	$20,000
Do	Sept. 19, 1890	15,000
Total		35,000

Glen Cove Harbor is in the collection district of New York.
The nearest light-house is on Sands Point, about 4 miles west.
Fort Schuyler, New York Harbor, is the nearest work of defense.

Money statement.

July 1, 1891, balance unexpended	$14,739.30
June 30, 1892, amount expended during fiscal year	14,501.93
July 1, 1892, balance unexpended	237.37
July 1, 1892, outstanding liabilities	16.00
July 1, 1892, balance available	221.37
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	10,221.37
Amount (estimated) required for completion of existing project	156,960.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of contract for extending breakwater at Glen Cove, N. Y., in force during the fiscal year ending June 30, 1892.

Name and address of contractor.	Date.	Subject.	Price per cubic yard.	Remarks.
John A. Bouker, New York City.	Dec. 23, 1890	Delivering riprap and extending breakwater.	*Cents.* 80	Contract completed Dec. 9, 1891. 16,244 cubic yards.

Commercial statistics for Glen Cove Harbor have been solicited and have not yet been received.

D 24.

IMPROVEMENT OF FLUSHING BAY, NEW YORK.

Flushing Bay is on the north shore of Long Island, about 14 miles by water from the Battery, New York City. The town of Flushing is on the east bank of Flushing Creek, just above the head of the bay. The bay is about 1 mile wide and 2 miles long; the bottom is of soft mud, nearly level, the depth in the original channel being not much greater than elsewhere. In 1861 a depth of 5 feet at low water was reported in the channel leading up to Flushing. At the beginning of the improvement by the United States the depth there was but 3.9 feet. The mean rise of tide is 7.1 feet

PROJECTS FOR IMPROVEMENTS.

A survey of Flushing Bay was made in 1878, and a project for improvement based upon the survey was proposed and adopted. This project provided for constructing two dikes, the first to extend northerly from the head (or south end) of the bay along the west side of the channel, then, bending, to continue westward to Herrick Point, at the west side of the mouth of the bay, thus forming a large tidal basin, which should fill and discharge through the main channel; the second to start from a point near the middle of the east shore and extend northwardly to the 6-foot curve, confining the channel. It also provided for dredging to make and maintain a channel 6 feet deep at mean low water. The estimated cost of this work was as follows:

Constructing 4,400 linear feet of pile dike, at $10 per foot	$44,000
Constructing 7,800 linear feet of pile dike, at $9 per foot	70,200
Constructing 900 linear feet of pile dike, at $7.50 per foot	6,750
Constructing 3,600 linear feet of single piling, at $3.70 per foot	13,320
For 83,000 cubic yards of dredging, at 20 cents per cubic yard	16,600
Contingencies	22,630
Total	173,500

All the timber work of the dike was to be creosoted.

The first appropriation was expended in building 3,057 linear feet of pile dike on the west side of the channel, extending northward from near the head of the bay. Subsequent appropriations until 1888 were expended in dredging to make and maintain the required channel depth, it being found necessary to dredge repeatedly in the same places. The total amount of material dredged in this period was about 235,000 cubic yards.

In September, 1888, a modification of the original project was approved, which provided for "extending the dike northward and towards the west side of the channel at College Point, and for dredging, omitting the dikes running westerly to Herrick Point, and the single row of piles on the east side." In 1891, owing to strong opposition to the dike by a large number of property owners at Flushing, College Point, and Newtown, further work upon it was discontinued, and the project was modified to provide for maintaining the channel by dredging only. Up to July 1, 1891, 4,663 linear feet of dike had been built; and the channel which had been repeatedly dredged had nearly the required depth of 6 feet at mean low water, but with less than 100 feet width.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

A contract for dredging was entered into June 30, 1891, approved July 6, 1891, with Charles and Henry E. Du Bois, at the rate of 18 cents per cubic yard, measured in scows. Work under this contract was begun early in July, and completed August 22, 1891, 73,849 cubic yards of mud being dredged, and deposited in deep water in Long Island Sound; the channel was made 90 feet wide and 8 feet deep at mean low water, where previous depth had been 5 to 7 feet; the additional depth was found expedient in order to retain the projected depth of 6 feet; the length of the channel dredged was 5,200 feet, beginning at the bend near the extreme south end of the dike; and continuing parallel to the dike, to deep water in Flushing Bay.

PRESENT CONDITION OF IMPROVEMENT.

The upper part of the dike has settled in places from a few inches to a foot; the lower part, built of sheet piling, partially protected by riprap, is left incompleted, and is considerably damaged by storms.

The channel in the bay, at the close of the work in 1891, had a depth of over 6 feet and width of 90 feet or over. It has filled in slightly from subsidence of the banks.

PROPOSED OPERATIONS.

Under the modified project, future appropriations will be applied to improving the channel by dredging.

Appropriations for improving Flushing Bay have been made as follows:

Application.	Date.	Amount.
Construction of dike	Mar. 3, 1879	$20,000
Dredging	June 14, 1880	15,000
Do	Mar. 3, 1881	10,000
Do	Aug. 2, 1882	5,000
Do	July. 5, 1884	10,000
Do	Aug. 5, 1886	10,000
Construction of dike and dredging	Aug. 11, 1888	15,000
Repair of dike and dredging	Sept. 19, 1890	20,000
Total		105,000

Flushing Bay is in the collection district of New York. The nearest light-house is on the North Brother Island, 3 miles to the northwest. The nearest fortification is Fort Schuyler, about 4 miles to the northeast.

Money statement.

July 1, 1891, balance unexpended	$15,500.02
June 30, 1892, amount expended during fiscal year	15,217.38
July 1, 1892, balance unexpended	282.64
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	10,282.64
Amount (estimated) required for completion of existing project	58,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of contract for improving Flushing Bay, New York, in force during the fiscal year ending June 30, 1892.

Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.	Remarks.
			Cents.	
Charles and Henry E. Du Bois, New York City.	June 30, 1891.	Dredging	18	Contract completed Aug. 22, 1891, 73,849 cubic yards.

Commercial statistics for Flushing Bay, New York, have been asked for, and have not been received.

D 25.

IMPROVEMENT OF PATCHOGUE RIVER, NEW YORK.

Patchogue River is a small stream on the south side of Long Island, emptying into Great South Bay, near the eastern end and about 55 miles in a direct line east from New York City. The village of Patchogue which lies about a mile north of the mouth of the river, has a resident population of about 5,000, which is considerably increased during the summer months.

The approach to the Patchogue River by water is through Fire Island Inlet, and thence by a rather crooked course for some 14 miles through Great South Bay; the depth through the bay and up to within half a mile of the river's mouth is about 8 feet; at the mouth of the river the depth shoals up to about 2 feet, which depth could be carried up to the village landings.

About the year 1870 the State of New York made an appropriation for improving the entrance to this river. A jetty about 1,000 feet long was built from the west side of the mouth of the river, and a channel dredged alongside of it. The jetty was built of a single row of sheet piling, with round piles at intervals of about 6 feet, and riprapped along the sides; in 1891 about 200 linear feet of the piling remained, but badly injured; the riprap could be traced for nearly the whole length of the work, but no trace of the dredged channel remained.

The mean rise of tide at the Patchogue River is 1.1 feet.

PROJECTS FOR IMPROVEMENT.

The river and harbor act of June 4, 1880, provided for a survey of the river, which was made that year; the report, dated October 30, 1880, and printed in the Annual Report of the Chief of Engineers for 1881, Part I, page 674, contained estimates for a plan of improvement as follows:

The estimate to secure a depth of 6 feet: at mean low water by dredging in the river, and from its mouth to the 6-foot curve in the bay is	$21,000
For diking, from river to 6-foot curve in bay	15,800
Engineering, contingencies, etc., 15 per cent	5,520
Total	42,320

One dike was to be on the west side of the river's mouth, and another and shorter one on the east side; the total length of the two to be about 2,400 feet, to be of carbolized timber filled with riprap, and to be from 5 to 7 feet wide from out to out.

Nothing had been done towards the desired improvement, and in 1886 another examination (ordered by the river and harbor act of that year) was made.

The report on this examination is printed in the Annual Report of the Chief of Engineers for 1887, Part I, page 759. This report contained a project and estimates for dredging a channel 60 feet wide and 6 feet deep from the highway bridge at Patchogue (4,000 feet above the mouth of the river) to the 6-foot contour in Great South Bay, a total length of about a mile, and to protect the channel in the bay by a dike or a jetty on its west side 1,700 feet long; the plan also mentioned the possible necessity of a dike on the east side, but it was not included in the estimates, which were as follows:

Dredging from the head of navigation at the bridge to the 6-foot contour in the Great South Bay, the channel being 60 feet wide and 6 feet deep, would require the removal, by scow measurement, of about 60,000 cubic yards of sand, at 30 cents per cubic yard	$18,000
Diking 1,700 linear feet, at $10 per linear foot	17,000
Superintendence, contingencies, etc	5,000
Total	40,000

Beginning of the work under this project was approved by the Secretary of War October 4, 1890, after Congress had made the first appropriation for the improvement, and up to July 1, 1891, 450 tons of stone had been placed, building 150 linear feet of the jetty, and partly completing 900 feet additional.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

At the beginning of the year work on the jetty was in progress, under a contract with E. Bailey & Sons, of Patchogue, N. Y., to furnish and place riprap at the rate of $2.80 per gross ton. During the fiscal year 2,552 tons of riprap were delivered and placed in the jetty, completing 900 linear feet of the work, which had been begun during the preceding year. The contract was completed October 9, 1891, 3,002 tons of stone having been delivered and 1,340 linear feet of jetty completed.

With the approval of the Chief of Engineers an agreement was made with Alonzo E. Smith to deepen the channel by dredging at the rate of 20 cents per cubic yard, prism measurement.

Work under this agreement was begun September 11, 1891, and up to the time of completion, January 16, 1892, 16,265 cubic yards of mud and sand were dredged and placed behind the jetty, making the channel 50 feet wide and 6 feet deep at mean low water extending from deep water in Great South Bay, shoreward and parallel with the jetty; the dredged channel was made about 1,850 feet long, and extends about 350 feet beyond the shore end of the jetty and into the mouth of the river.

PRESENT CONDITION OF IMPROVEMENT.

The jetty is in good condition; it is 1,340 feet long, 3 feet wide on top, and stands about 1 foot above mean high water; its outer end is in 4½ feet depth of water.

The dredged channel has filled considerably, owing to the subsidence of the very soft banks.

The available depth of the river above the dredged channel is about 2 feet at mean low water.

PROPOSED OPERATIONS.

Future appropriations should be applied to completing the dredged channel, and to extending the jetty, as contemplated by the project.

The only appropriation for Patchogue River is the one of $15,000, made in 1890.

Patchogue River is in the collection district of New York. The nearest light-house is at Fire Island Inlet, 14 miles southwest. The nearest work of defense is Fort Hale, New Haven Harbor, Connecticut, about 35 miles in a direct line northward.

Money statement.

July 1, 1891, balance unexpended	$14,843.82
June 30, 1892, amount expended during fiscal year	13,584.83
July 1, 1892, balance unexpended	1,258.99
July 1, 1892, outstanding liabilities	77.37
July 1, 1892, balance available	1,181.62
Amount appropriated by act approved July 13, 1892	8,000.00
Amount available for fiscal year ending June 30, 1893	9,181.62
Amount (estimated) required for completion of existing project	17,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	17,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of contracts for improving Patchogue River, N. Y., in force during the fiscal year ending June 30, 1892.

Name and address of contractors.	Date of contract.	Subject of contract.	Price.	Remarks.
E. Bailey & Sons, Patchogue, N. Y.	Apr. 18, 1891	Delivering riprap and constructing breakwater.	$2.80 per ton.	Work completed Oct. 9, 1891. 3,002 tons delivered and placed.
Alonzo E. Smith, Islip, N. Y.		Dredging	.20 per cubic yard.	Work completed Jan. 16, 1892. 16,265 cubic yards.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1891.

Arrivals and departures of vessels.

[Draft, from 4 to 9 feet; tonnage, from 10 to 500 tons.]

Steamers	100
Sail vessels	750
Barges	300
Total	1,150

Freight received and shipped by water.

	Tons.	Estimated value.
Received	90,000	$1,000,000
Shipped	15,000	350,000
Total	105,000	1,350,000

The principal articles of commerce by water are coal, wood, brick, stone, lumber, oysters, and general merchandise.

"In addition to the above there are a number of improvements in the way of docks, dredging, etc., in progress, that are the direct result of the Government work that has been done at this place, and during the present year there will be more vessels run from our place, including one large freight steamer, which will probably add 30,000 tons to receipts and 20,000 tons to the shipments of this port."

D 26.

IMPROVEMENT OF BROWNS CREEK, SAYVILLE, LONG ISLAND, NEW YORK.

Browns Creek is a small stream flowing midway between the villages of Sayville and Bayport, near the south shore of Long Island, and emptying into Great South Bay, about 11 miles northeast of Fire Island Inlet. From Fire Island Inlet to the vicinity of Browns Creek there is a rather crooked channel of about 8 feet available depth. The original entrance to the creek was crooked, narrow, and shifting. Its depth at mean low water was about .4 foot. In the stream itself the low-water level was from .3 to 1.3 feet higher than low water in Great South Bay and the channel depths from zero to 3 feet below low water in the bay. The width of the stream from the bay to the highway bridge, about 5,000 feet, averages 77 feet. Its course lies through a sandy marsh from one-quarter to one-half mile in width, separated from the bay by a low and narrow beach. In its natural condition this stream was not available for any purpose of navigation.

The permanent population of Sayville is said to be 3,500.

The mean rise of tide in Great South Bay is 1.1 feet; at the highway bridge, except in dry seasons, it is scarcely noticeable.

PROJECT FOR IMPROVEMENT.

In pursuance of the river and harbor act of August 11, 1888, a survey of Browns Creek was made, the report on which was printed in House Ex. Doc. No. 22, Fifty-first Congress, first session, and also in he Annual Report of the Chief of Engineers for 1890, Part I, pages 669-674. With this report plans and estimates for work were presented as follows: "The object of the desired improvement is to secure an anchorage ground or place where the fishing boats can lie in safety during rough weather. This can be accomplished by widening and deepening the creek and improving its mouth. To prevent the entrance from filling up by drift and wave action, jetties will probably be needed on both sides, certainly on the west side, as the drift of sand along the shore is from west to east. The jetties should be of riprap, the top and slopes to be of stone weighing not less than one-fourth ton, the top to be 3 feet wide, and 1 foot above high water, with slopes of 1 on 1. The stone on the top and slopes should be selected and carefully laid, so as to present as smooth a surface as possible to resist the action of the moving ice.

The cost of dredging a channel 100 feet wide and 6 feet deep at mean low water, from the 6-foot curve in the bay up to the first bend in the creek (1,850 feet) is estimated to be:

33,000 cubic yards at 30 cents per cubic yard, the material to be deposited in the bay	$9,900
For a 4-foot channel 100 feet wide above this point to the highway bridge, 4,680 feet, 86,000 cubic yards, at 14 cents per cubic yard, the material to be placed on the banks	12,040
Cost of west jetty, 1,600 feet long, 3,700 cubic yards of riprap, at $2.50 per cubic yard	9,250
Cost of east jetty, 1,400 feet long, 3,100 cubic yards of riprap, at $2.50 per cubic yard	7,750
Contingencies	7,060
Total	46,000

The first work to be done should be the deepening at and near the mouth, and the construction of jetties, commencing at the shore end. These works should be carried on simultaneously.

This improvement would not only benefit those engaged in oystering and fishing, but would enable many articles of commerce to be brought to Sayville by water instead of by rail, as at present. A partial improvement would be of great benefit to small vessels.

The beginning of work under this project was approved by the Secretary of War, October 4, 1890, after the first appropriation for improving Browns Creek had been made; work had not been begun up to July 1, 1891.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

Under date of April 18, 1891, a contract was entered into with E. Bailey & Sons, for construction of jetties at the mouth of the river, by delivering and placing riprap gneiss, at the rate of $2.80 per gross ton.

Work under this contract was begun August 25, 1891, and up to the close of the fiscal year 1,520 tons of riprap had been delivered and placed, building 492 linear feet of the west jetty and 275 linear feet of the east jetty, with an additional 175 feet partly completed. The contract has been extended; the unfinished part of the east jetty will be completed.

With approval of the Chief of Engineers, an agreement was made with Mr. Alonzo E. Smith to dredge and deepen the channel, at the rate of 20 cents per cubic yard, prism measurement. Dredging was begun October 2, 1891, and completed January 30, 1892, 23,194 cubic yards of sand and mud being dredged and deposited upon adjacent banks, making a channel about 1,450 feet long, 100 feet wide, and 4 feet deep at mean low water, extending from deep water in Great South Bay about 1,150 feet inside the mouth of the creek.

PRESENT CONDITION OF IMPROVEMENT.

The west jetty is 492 feet long, and the east jetty is completed for 275 feet, with dimensions of 3 feet top width, at level of 1 foot above mean high water; the additional 175 feet of the east jetty are partly built.

The dredged channel has shoaled somewhat from wave action and from subsidence of the banks; it is now used by many of the small boats of the vicinity for night anchorage, and two arms have been dredged by private parties, extending into the east marsh, for similar use; the smaller of these is 25 feet wide, the larger 50 feet wide; their total length is about 1,500 feet. The boats using this channel are in general the small oyster sloops, owned and operated in the vicinity, with draft of 2 to 5 feet; it is reported that 115 of these vessels, by actual count, have taken shelter in the harbor at one time.

PROPOSED OPERATIONS.

With available funds the east jetty will be completed to a length of 450 feet.

Future appropriations will be applied to maintaining and extending the channel, and to completing the jetties, as contemplated in the project.

The only appropriation for improving Browns Creek is the one of $12,000, made by act of Congress approved September 19, 1890.

Browns Creek is in the collection district of New York.

The nearest light-house is at Fire Island Inlet, about 11 miles southwest.

The nearest works of defense are the fortifications at Willets Point, New York, about 35 miles west, and Fort Hale, New Haven Harbor, Connecticut, about the same distance northeastwardly.

Money statement.

July 1, 1891, balance unexpended		$11,929.16
June 30, 1892, amount expended during fiscal year		10,457.76
July 1, 1892, balance unexpended		1,471.40
July 1, 1892, outstanding liabilities	$537.60	
July 1, 1892, amount covered by uncompleted contracts	560.00	
		1,097.60
July 1, 1892, balance available		373.80
Amount appropriated by act approved July 13, 1892		5,000.00
Amount available for fiscal year ending June 30, 1893		5,373.80
Amount (estimated) required for completion of existing project		29,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of contracts for improving Browns Creek, New York, in force during the fiscal year ending June 30, 1892.

Name and address of contractor.	Date of contract.	Subject of contract.	Price.	Remarks.
E. Bailey & Sons, Patchogue, N. Y.	Apr. 18, 1891	Delivering riprap and construction of jetties.	$2.80 per ton..	Contract extended to July 1, 1892.
Alonzo E. Smith, Islip, N. Y.	....	Dredging.........	0.20 per cubic yard.	Work completed Jan. 30, 1892, 23,194 cubic yards.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1891.

Draft of vessels using harbor ....feet..	from 2 to 5
Number of oyster boats and small vessels belonging in harbor	240
Amount of oysters taken during the year, by vessels belonging in harbor ....bushels..	225,000
Number of vessels (estimated) using harbor for shelter, or for night, which could not have used it before improvement...............over..	200
Largest number of vessels observed at one time in the harbor...........	115

LETTER OF MR. JOSEPH WOOD.

SAYVILLE, LONG ISLAND, N. Y., *June 16, 1892.*

MY DEAR SIR:

* * * * * * *

There were brought into and planted in the Great South Bay, in the year 1891, by vessels harboring in this vicinity, according to careful information, 175,000 bushels of seed oysters from other oyster grounds.

There have been several oyster houses (establishments from which oysters are shipped in barrels) erected during the year in the vicinity of this improvement, which has become a center for this trade.

One establishment for hauling out upon railways and repairing boats has been set up near the improvement on a canal dug out for the purpose at private expense.

Proceedings are now pending for the opening and laying out of two public highways and landings for the more convenient approach and use of the improvement by the public.

Yours, very respectfully,

JOSEPH WOOD,
For the Village Improvement Society of Sayville, etc.

To Col. D. C. HOUSTON,
Corps of Engineers, U. S. Army.

D 27.

ESTABLISHMENT OF HARBOR LINES AT FIVE-MILE RIVER HARBOR, CONNECTICUT.

ROWAYTON, CONN., *October 12, 1891.*

DEAR SIR: Will you kindly inform me what course to pursue to establish harbor lines at this port? I ask for information for the people of this community, who feel that their rights to our small harbor are to be trespassed upon by some of the wharf owners along the water front. We have just finished the second Government appropriation for dredging October 9, which extends from the mouth up and near the center of the harbor. The first wharf in coming up the harbor is at a point making the harbor more narrow than elsewhere, I think about 300 feet in width. The wharf at this point is to be extended about 50 feet farther out in the harbor to avoid the expense of dredging and get more wharf, taking advantage of our citizens on the plea that we can not get harbor lines established, as we are not under a corporation. Capt. John McNeil, who has been for many years harbormaster at the port of Bridgeport, Conn., advised me to write to your honorable sir for information.

Respectfully yours,

Capt. O. S. YOUNG.

Hon. REDFIELD PROCTOR,
Secretary of War.

* * * * * * *

[Third indorsement.]

ENGINEER OFFICE, U. S. ARMY,
New York, January 22, 1892.

Respectfully returned to the Chief of Engineers with report of this date recommending the establishment of harbor lines at the harbor of Five-Mile River, Connecticut. Capt. Young and others interested have been consulted, and the lines proposed are generally satisfactory to them.

D. C. HOUSTON,
Colonel, Corps of Engineers.

REPORT OF COLONEL D. C. HOUSTON, CORPS OF ENGINEERS.

ENGINEER OFFICE, U. S. ARMY,
New York, January 22, 1892.

GENERAL: Referring to the accompanying letter of Capt. O. S. Young, dated October 12, 1891, on the subject of harbor lines at the harbor of Five-Mile River, Connecticut, I have the honor to transmit a tracing* showing proposed harbor lines at that harbor, which I recommend for approval. The parties interested have been consulted and the lines indicated meet with general approval. They provide a sufficient waterway for general navigation and leave ample room for the construction of wharves. The bulkhead and pierhead lines are identical. Such lines are necessary for the preservation and protection of the harbor.

The project for improvement adopted in 1888 contemplates a channel 8 feet deep at mean low water, 100 feet wide and about 6,000 feet in length, from Long Island Sound to the head of the harbor as indicated on the tracing, at an estimated cost of $25,000. The sum of $10,000 has been appropriated and $9,886.94 expended, making a channel 8 feet deep at mean low water and 60 feet wide from Long Island Sound up the harbor for a distance of 2,400 feet.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Colonel, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

---

*Not printed.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
January 25, 1892.

Respectfully submitted to the Secretary of War.

The subject of the establishment of harbor lines in the harbor at Five-Mile River, Connecticut, having been brought to the attention of the Secretary of War, the matter was referred to Col. D. C. Houston, Corps of Engineers, the officer in charge of the district in which this locality is situated, for report.

Col. Houston submits report dated January 22, 1892, and recommends for the approval of the Secretary of War the harbor and dock lines mentioned in the within report and delineated upon the accompanying chart.

It is recommended that the lines selected be approved, and that the secretary place his approval both upon the report and the tracing submitted.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Second indorsement.]

WAR DEPARTMENT, *January 26, 1892.*

Approved.

L. A. GRANT,
Acting Secretary of War.

APPENDIX E.

IMPROVEMENT OF HUDSON RIVER; OF HARBORS AT SAUGERTIES AND RONDOUT, AND WAPPINGER CREEK; OF NEW YORK HARBOR AND RIVERS AND HARBORS IN ITS VICINITY, NEW YORK; AND OF RARITAN BAY, NEW JERSEY.

REPORT OF LIEUTENANT-COLONEL G. L. GILLESPIE, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Hudson River, New York.
2. Harbor at Saugerties, New York.
3. Harbor at Rondout, New York.
4. Wappinger Creek, New York.
5. Harlem River, New York.
6. East River and Hell Gate, New York.
7. Newtown Creek, New York.
8. Buttermilk Channel, New York Harbor.
9. Gowanus Bay, New York.
10. New York Harbor, New York.
11. Raritan Bay, New Jersey.
12. Removing sunken vessels or craft obstructing or endangering navigation.

EXAMINATION AND SURVEY.

13. For canal from main channel from Jamaica Bay easterly to Long Beach Inlet, New York.

HARBOR LINES.

14. Establishment of harbor lines in New York Harbor and its adjacent waters.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., July 9, 1892.

GENERAL: I have the honor to transmit herewith annual reports for the fiscal year ending June 30, 1892, upon the works of river and harbor improvement under my charge.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

E 1.

IMPROVEMENT OF HUDSON RIVER, NEW YORK.

The Annual Report of the Chief of Engineers for 1885, Part I, page 677, contains a history of this improvement accompanied by original reports and two sketches showing its condition at that time.

The only part of the Hudson River which has been improved by the General Government is a stretch, about 20 miles long, beginning at the head of navigation at Troy, N. Y., about 6 miles above Albany, and extending down the river to New Baltimore, about 14 miles below Albany.

While there has always been enough water below New Baltimore for navigation, this upper section of the river, so far as its history is known to us, has always been obstructed by bars and shoals, due to the existence of numerous islands and sloughs and the consequent diversion of the river's waters through too many channels.

Prior to 1831, when the jurisdiction of the Federal Government over these waters was confirmed by judicial decision, the State of New York had made efforts to improve the navigation of this part of the river.

Since 1831 the improvement of the Hudson River has been conducted both by the State of New York and by the General Government, both building and repairing dikes and doing such dredging as seemed necessary. In the last few years, however, the dike work has been left almost exclusively to the General Government, and the dredging to the State of New York.

The general system of improvement has been the same throughout—the contraction of the channels by the construction of jetties and dikes intended to deepen them by means of the scour so produced, and also the lowering of the bed by dredging where such work was indispensable.

But up to 1831 the work, which had consisted almost entirely of the construction of spur dikes and dredging, had produced very little permanent improvement.

After 1831, however, the United States began the present general system of improvement, which consists of contracting the channel by means of longitudinal dikes intended to aid in scouring the bars and shoals, instead of which spur jetties had formerly been used.

Under this system the United States constructed two dikes in 1835, 1836, 1837, and 1838.

Then followed a long interval of time in which nothing was done by the United States except in 1852; but in 1863 the State of New York took up the improvement on the general plan adopted by the United States in 1831, viz, substituting a system of longitudinal dikes instead of the jetty system, and between 1863 and 1867 built six important longitudinal dikes of this kind. (Annual Report of 1885, page 678.)

The work was again taken up by the United States in 1864, when, out of the general sum appropriated for river and harbor improvements, $33,000 was allotted for the Hudson River improvement, and this was followed by the act of June 23, 1866, which appropriated $50,000 for the same work.

The plans under which the present works of improvement of the river are conducted were adopted in 1866, and provide for securing a navigable channel 11 feet deep at mean low water from New Baltimore up to Albany, and 9 feet deep at mean low water from Albany up to Troy.

The range of tides, determined in 1876, is 2 feet at Troy, 2.32 feet at Albany, and 3.43 feet at New Baltimore.

The following is a description of the plan:

First. A system of longitudinal dikes to confine the current sufficiently to allow the ebb and flow of the tidal current to keep the channel clear. These dikes to be gradually brought nearer together from New Baltimore towards Troy, so as to assist the entrance of the flood current and increase its height, their height to be kept approximately at the level of the tidal high water, so as not to confine the freshets; the exact level, however, being left to be determined by experience as the work progresses.

Second. That the dredge be used so far as necessary to open the channels above described, which the current should not be allowed to do, except very gradually, lest accumulations dangerous to navigation be formed below.

Third. Keeping, as far as practicable, the side reservoirs open to the passage of tidal currents by gaps at their lower extremities, in order to increase the tidal flow.

Fourth. Dumping all dredged material in secure places, where it can not be moved back again into the channel by the current.

Fifth. Constructing the dikes of timber and stone, in a manner to secure their permanency, at a minimum cost, the details varying with the locality, to be left to the discretion of the local engineer, to be so designed as to admit of having an increased height given to the dikes if necessary.

Sixth. To protect, when necessary, the banks and islands against the abrading action of the currents by revetments.

Seventh. That limits, beyond which no encroachments upon the channel should be made, be prescribed, and that any such encroachments be reported to the engineer in charge.

The latest revised estimate of cost of this improvement is $1,424,435.

From the nature of the materials which enter into the construction of the dikes and from the limited sums which are applied annually to renew the parts which become unserviceable, whether by natural decay or otherwise, it can be well understood that the estimates prepared from time to time for the completion of the project must be accepted as approximately accurate for only a short period of time. This statement is necessary for a correct understanding of the apparent discrepancy between the estimated cost of the project and the sums which have been appropriated for its execution.

The State of New York makes an appropriation at every session of its legislature for the improvement of the Hudson River, and prior to 1867 the money was applied to the construction of dikes on the left bank of the river from Houghtailing Island to Albany, to jetties, dams, and to temporary measures of relief, and also to dredging at the points where shoals were discovered after spring freshets. In the last few years, however, the dike work has been left almost exclusively to the General Government and the dredging to the State.

The growth of obstructive bars in the river was found to be so great after the spring freshets had subsided in 1891 as to require dredging to give immediate relief. During the spring and summer of that year, 55,148 cubic yards of material were removed in that way from different bars in the channel, extending from Mulls Cross-Over to the United States Arsenal at West Troy, and it is expected that a certain part of every future appropriation will be applied in like manner whenever the free navigation of the river becomes obstructed by like causes, Sections 6 and 7 of the river and harbor act of September 19, 1890, make it unlawful to dump into the navigable waters of the United States any materials which shall tend to impede or obstruct navigation, or to excavate or fill or in any manner to alter or modify the course, location, condition, or capacity of the channel of said navigable waters, unless approved and authorized by the Secretary of War. These are wise provisions for the protection of the navigable waters of the United States, and it is hoped that a considerate enforcement of the law will serve hereafter to protect the channel of the river by maintaining its regimen, and at the same time to allow material to be taken freely from the river for private and public uses.

The average rainfall covering the past sixty-three years, from observations recorded in the report of the water commissioner of Troy, N. Y., for 1889, is 36.55 inches. The greatest rainfall in any year was recorded in 1878, when 49.23 inches fell; the least rainfall in any year occurred in 1839, when 18.32 inches fell. The greatest known rainfall in any one month occurred in October, 1869, when 13.8 inches fell; the least known rainfall in any one month was in May, 1840, when only 0.2 of an inch fell.

At times during the dry season of most every year, for a month at least, no water flows over the State Dam at Troy, and excepting what comes in through the lockage of the canals there is, during that period, little apparent fresh-water supply to the flow of the river. From this and the fact that the tide rises and falls at the State Dam, it is evident that the navigation of the Hudson River at the low stage is dependent in a large degree upon the tidal prism of the river.

The mean rise and fall of tides—

	Feet.
At State Dam, Troy, N. Y., is	0.80
At Nail Works, Troy, N. Y., is	1.92
At Albany, N. Y., is	2.32
At Castleton, N. Y., is	2.53
At New Baltimore, N. Y., is	3.42
At New York, Governors Island, from Coast Survey	4.40

The mean duration of rise of tide at Albany is 5 hours 0 minutes, and the mean duration of fall, 7 hours 25 minutes.

The plane of mean low water at New York is below that—

	Feet.
At New Baltimore	3.55
At Castleton	4.35
At Albany	4.78
At Troy Nail Works	5.32
At Troy State Dam	6.88

The plane of mean high water at New York is below that—

	Feet.
At New Baltimore	2.57
At Castleton	2.48
At Albany	2.70
At Troy Nail Works	2.84
At State Dam, Troy	3.28

The heights of the greatest known freshets above the plane of mean low water at Albany are as follows:

That of February 9, 1857, due to an ice gorge at Van Wies Point, was 22.19 feet.

That of October, 1869, due to the great rainfall in that month, which reached 13.8 inches, was 19.04 feet.

That of February, 1886, due to an ice gorge, was 17.89 feet.

Generally speaking, the effects of rainstorms are shown by a rise in the river within twenty-four hours. The winds also materially affect the height of the water; south and east winds drive the water up the river, causing very high tides, while a north or west wind produces an opposite effect.

The river and harbor act of September 19, 1890, authorized and directed the Secretary of War to appoint a Board of three officers of the Corps of Engineers—

> Whose duty it will be to thoroughly examine the obstructions to navigation in the Hudson River between New York City and the State Dam at Troy, N. Y., and report a project and estimate of the cost of widening and deepening said river between New York City and the city of Albany, and also between New York City and the State Dam at the city of Troy, for the navigation of seagoing vessels drawing 20 feet of water, and also a separate estimate of the expense of improving the river between Coxsackie and the State Dam at Troy, to such an extent as to secure a navigable channel 12 feet deep at mean low water. Said Board shall accompany their report with a statement as to the usefulness of such improvements and of their relations and value to commerce, and of the advisability of entering upon the same at this time.

The report of the Board of Engineers constituted under this act by Special Orders No. 66, Headquarters, Corps of Engineers, September 30, 1890, was submitted to the Chief of Engineers October 1, 1891, and was published as House Ex. Doc. No. 23, Fifty-second Congress, first session. It will be found as an appendix to this report.

The Board recommended for adoption the improvement of the Hudson River "between Coxsackie and the State Dam at Troy to such an extent as to secure a navigable channel 12 feet deep at mean low water"—the channel to Troy to be 400 feet wide, and thence to the State Dam 300 feet wide.

The Board further recommended that "the regulating works between Troy and New Baltimore," provided for in the previous project of 1867, be maintained, and that "supplementary regulating works of a permanent character be provided between New Baltimore and Coxsackie." The estimated cost of the recommended project was $2,500,000, approximately.

BRIDGES ACROSS THE HUDSON RIVER.

The following table gives the location and essential features of all the bridges which cross the line of navigation of the river:

Name and location of bridge.	Draw span.	Width in clear in each draw.	Height of bottom chords above mean high water.	Remarks.
	Ft. In.	*Ft. In.*	*Ft. In.*	
New York Central and Hudson River Railroad Bridge at Bridge avenue, Troy, N. Y.	198 6	61 6	23 10	Railroad, wagon, and passenger bridge; iron, on stone piers; draw pier on land, east shore; the only opening through which boats ply is 56 feet 6 inches in clear from dock line, east shore; draw opened by steam power; four piers in main channel of river east of Starbuck Island; respective widths in clear between piers, 170 feet 6 inches, 173 feet 6 inches, 173 feet 6 inches, and 160 feet to east shore-line of Starbuck Island; two piers in channel of river west of Starbuck Island; width in clear from west shore-line of Starbuck Island to first pier, 150 feet 5 inches; between first and second piers, 177 feet 5 inches; and from second pier to Green Island dock line, 68 feet 6 inches, making six piers in river at right angles to direction of stream.

Name and location of bridge.	Draw span.	Width in clear in each draw.	Height of bottom chords above mean high water.	Remarks.
	Ft. In.	*Ft. In.*	*Ft. In.*	
Congress Street Bridge, Troy, N. Y.	258 0	104 0	29 6	Wagon and passenger bridge; double draw, opened by hand power; iron, on stone piers, slightly oblique to direction of stream; two piers and draw pier in river; width in clear from east pier to dock, 205 feet 3 inches; width in clear from west pier to West Troy shore-line, 210 feet.
New York Central and Hudson River Railroad Upper Bridge, Albany, N. Y.	275 0	110 7	33 5	Railroad freight bridge; double draw, opened by steam power; iron, on stone piers at right angles to direction of stream; four piers and draw pier in river between bulkhead lines; respective widths in clear, 148 feet, 170 feet, and 170 feet, commencing at Columbia Pier dock line.
New York Central and Hudson River Passenger Railroad Bridge, Albany, N. Y.	275 0	115 4	28 1	Railroad and passenger bridge; double draw, opened by steam power; iron, on stone piers at right angles to direction of stream; four piers and draw pier in river; respective widths in clear, 146 feet 5 inches, 175 feet, 175 feet, and 119 feet, commencing at Columbia Pier dock line.
Lower Bridge or Greenbush Bridge, Albany, N. Y.	400 0	169 8	22 7	Wagon and passenger bridge; double draw, opened by steam power; iron, on stone piers at right angles to direction of stream; two piers and draw-pier in river; width in clear from west pier to Quay Street dock line, 186 feet 3 inches; width in clear from east pier to shore-line pier, 236 feet 3 inches.
The Poughkeepsie Bridge, Poughkeepsie, N. Y.	....	....	160 0	No draw; railroad bridge; iron, on iron piers with stone foundations at right angles to stream; four piers in river; five spans, 548 feet, 525 feet, 546 feet, 525 feet, and 548 feet; cantilever bridge.

In addition to the foregoing, the following bridges have been authorized by Congressional or State legislation:

(1) Bridge of the North River Bridge Company, across the Hudson River at Twenty-third street, New York City. Authorized by act of Congress July 11, 1890. The plans, approved by Secretary of War, December 29, 1891, provide for an eight-track railroad bridge with a single span and with a clear headway at center of span of 150 feet above mean high water of spring tides, under any condition of load or temperature, and a clear headway at the piers of not less than 140 feet.

(2) Bridge of the New York and New Jersey Bridge Company, across the Hudson River north of Tenth street and south of One hundred and eighty-first street, New York City. A company was granted a charter, under the above name, by the State of New Jersey, under provisions of act approved April 17, 1868, supplemented by provisions of chapters 85, 86, and 87, laws of 1891; and the State of New York authorized the construction of the bridge by a company of this name by chapter 253, laws of 1890. Since the passage of the above acts the companies have been consolidated. The plans provided for a railroad bridge with an elevation at the towers of 145 feet in the clear above high-water mark, and 155 feet in the clear at the center of the main span. No law has as yet been enacted by Congress authorizing the construction of this bridge.

(3) Bridge of the Albany and Bath-on-the-Hudson Bridge Company, across the Hudson River at Bath-on-the-Hudson. Authorized by act of the State of New York approved April 11, 1892. The plans, which have not yet been approved by the Secretary of War, provide for a toll bridge for wagons and passengers, to be built of iron on stone piers, not less than 20 feet above ordinary tide water; the draw to have two openings each not less than 150 feet in width; the piers, other than

draw piers, to be not less than 150 feet from center to center; and the bridge to be commenced within one year after approval by Federal authorities, and to be completed within three years from date of such approval.

The Hudson Tunnel Railway Company, which is constructing a tunnel from Fifteenth street, Jersey City, to Morton street, New York City, was authorized July 3, 1891, by the Secretary of War, to place not exceeding 20,000 cubic yards of clay upon the bed of the channel on the approach to the New York side, and the supervision of the work under the above authority was given to this office.

The company reported to this office, under date of September 29, that efforts were being made in England to get the necessary money for proceeding with the work, but nothing has been done, however, under the authority of the Secretary of War, for reasons not definitely stated to this office.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

At the beginning of the fiscal year, July 1, 1891, the following contracts were in force: With William Fuller & Sons, dated January 13, 1891, for the construction of certain new dikes and the repairing of certain existing dikes in the Hudson River between Troy and New Baltimore, enumerated in the last Annual Report; with E. M. Payn & Co., dated February 20, 1891, for dredging at Washington Bar, Fish House Shoal, Bogart Light Shoal, and Winnies Bar, and with P. W. Myers, dated February 20, 1891, for dredging at Mulls Cross-Over.

Besides these, an open-market agreement was in force with E. M. Payn & Co. to remove 15,000 cubic yards of material at Kellogg Shoal, at the previous contract price for like work.

The work under contract with William Fuller & Sons was continued until the 19th of December, 1891, when, on account of cold weather and ice in the river, the work was stopped. Owing to the difficulty in getting material throughout the season, the contractors were unable to complete the contract in the specified time, and, upon application, an extension was granted until December 1, 1892.

Work was resumed April 21, 1892, and is now in progress, chiefly upon repairs to the Patroon Lower Island Dike.

The contract with E. M. Payn & Co., for dredging, was fully completed September 20, 1891, and the contract with P. W. Myers was completed August 29, 1891.

In addition to the above the plant of dredging contractors was employed on open-market agreement at previous contract rates for service dredging, removing wrecks, removing broken stone, driving piles, and for transporting material.

The progress made during the fiscal year ending June 30, 1892, under the above contracts and open-market agreements may be summarized as follows:

CONSTRUCTION OF NEW DIKES.

Mulls Plaat Dike.—During the fiscal year this dike has been extended 800 feet south from the ice-house dock, Mulls Plaat, along the shore of this island to protect it from erosion. It was built under the contract with William Fuller & Sons, and is constructed after the manner of a half dike. A row of piles was driven along its face, connected by a double course of waling timber, and tied back to anchor piles driven in the rear, and the structure then filled with stone. It was completed August 1, 1891, at an average cost per running foot of $3.37.

Mulls Dike.—Under contract with William Fuller & Sons this has been extended from the end of the stone revetment built in 1890, which is 565 feet north of Mulls Lower Beacon, to Shad Island—a distance of 2,535 feet. This extension consists of a row of piles, driven front and rear, connected by a double course of waling timbers, and tied together by wooden cross-ties and iron tie bolts. It is built along the line of the old single-pile dike in a depth of water varying from 6 to 10 feet, and is 12 feet wide from out to out of piles, and stands 1½ feet above mean high water. It is filled with ordinary rubblestone chinked in with quarry spalls and topped off with large stone. Its construction is still in progress, but a few hundred cubic yards only of large stone are required to complete it. Its cost per running foot is $12.

Nine Mile Tree Dike.—This dike, built under contract with William Fuller & Sons, is constructed on the plan of a half dike to protect the shore of Upper Schodack Island from erosion. It was begun August 8, 1891, and completed December 5, 1891. Its total length is 1,735 feet, and cost per running foot $3.74.

In the construction of these new dikes the following material was furnished and put in by the contractors:

126,943 linear feet pine piling.
150,936 feet B. M. square timber.
39,805 pounds tie rods and screw bolts.
22,186 pounds drift bolts and washers.
2,666 linear feet round timber.
17,133 cubic yards stone.
2,500 cubic yards dredged material.

REPAIRS TO EXISTING DIKES.

Base Island Crib Dike.—This dike, 2,700 feet long, was to have been repaired by building over the old structure an embankment of large stone, backed and chinked with small stone. During the fiscal year, 382 cubic yards of stone were delivered and put in. The further repairs to this dike were abandoned, so as to concentrate operations on the repairs to Patroon Lower Island Dike, a more necessary work.

Bath Dike.—This dike was repaired by stone filling where settlement had taken place. A portion of the dike was rebuilt by an embankment of stone thrown up over the old structure. Material furnished and put in the work, 1,023 cubic yards of rubblestone.

Overslaugh Dikes Nos. 1 and 2.—For a length of 7,000 feet the paving along the face of these dikes was badly damaged by the action of ice, and in many places wholly destroyed. The work of repairing and repaving these dikes, which was in progress at the end of the last fiscal year, was completed December 10, 1891. A timber skew back was built by the contractor where the old structure had been carried away, and 3,992 cubic yards of paving stone furnished. The work of repaving was done by hired labor. These dikes, excepting a length of about 700 feet, which was not repaired, are now in excellent condition.

Campbell Island Dike.—The repairs to this dike were only completed in part. Piles were driven where gaps occurred, new timber put on where the old had been torn off, and the dike filled with stone. Some slight additional repairs, such as putting on new waling timber along the old single-pile dike, yet remain to be done, but owing to prevalence of high water due to freshets the contractor has been unable to start them.

Cow Island Dike.—This dike was fully repaired according to the specifications. A passage for small boats belonging to riparian owners was made and floored with plank, and a few necessary new timbers were put in, and the whole structure filled with stone where settlement had taken place.

Castleton Dike.—The upper end of this dike was in very bad condition, as many of the piles and much of the waling timber had been destroyed by the action of the ice. It was thoroughly repaired by the contractor during the fiscal year. New piles were driven, new timber put on where necessary, and the dike filled with stone where settlement had taken place.

Material used:

671½ linear feet pine piles.
4,850 feet B. M. square timber.
2,000 pounds iron tie rods and screw bolts.
202 cubic yards stone.

Bogart Island Dike.—Under open-market agreement with William Parrott, dated October 10, 1891, this dike was partly repaired. Piles had been removed and the timbers torn off in many places. It was expected that these repairs would be completed during the fall of 1891, but, on account of delays on the part of the contractor, they were not completed when the cold weather put a stop to the work. The freshets thus far this season have prevented resumption of the work.

The following material has been put in place in the dike:

4,007 linear feet pine piles.
1,368 feet B. M. square timber.
1,400 pounds iron screw bolts and drift bolts.

Besides the above repairs, some necessary work has been done by open-market agreements. During the spring of each year, when navigation first opens, many of the dikes are completely submerged by the freshets. This exposes navigation to great risks, and to obviate them it has been customary to drive guide piles at different points to mark the position of the dikes. This work, which required the use of 557 linear feet of pine piles, has been done satisfactorily this year by William Fuller & Sons under open-market agreement.

The north end of Coeymans Middle Dike, which is shod with iron to protect it from the action of ice, projects somewhat into the channel. During the season of 1891 a canal boat in one of the tows struck this dike and sunk. To prevent similar damage to other boats a cluster of oak fender piles was driven at this point.

At Overslaugh Rock, William Fuller & Sons constructed, in August, a timber framework for ranges to mark out the rock, which was in course of removal by the use of the United States drill scow *Hudson*. When the work was stopped on account of cold weather in the fall of 1891, the piles were drawn and the timber work removed. This framework was rebuilt this spring to arrange for the continuation of the work of removing the rock.

Material used:

535 linear feet pine piling.
756 feet B. M. square timber.
45 pounds spikes.

DREDGING.

A comparatively large amount of useful dredging has been done during the year, either by contract or by open-market agreement at contract rates.

Mulls Cross-Over.—The work under contract with P. W. Myers, which was in progress at the end of the last fiscal year, was completed August 29, 1891. The channel for a distance of 1,200 feet was straightened, and by the removal of 27,000 cubic yards of material was given a navigable width of 150 feet, and a depth of 11 feet, mean low water.

As the result of the work navigation at this cross-over has been much benefited. The construction of Mulls Dike Extension to Shad Island has assisted in maintaining this channel, which is now in better condition than ever before.

Kellogg Bar.—Under the open-market agreement with E. M. Payn & Co., the dredging at Kellogg Bar was completed July 11, 1891. During the fiscal year 2,795 cubic yards of material were dredged and removed. The accretions to this bar which made dredging necessary were due to an ice gorge which formed in the winter of 1890-'91. Since the dredging was completed navigation has been perfectly free.

Washington Bar.—Under the same contract with E. M. Payn & Co. dredging was done at Washington Bar and a channel opened from deep water below to and along the face of the Arsenal Dock at West Troy. The material removed measured 9,858 cubic yards, and the contract was completed September 20, 1891.

Overslaugh.—To prepare for the drilling and blasting of Overslaugh Rock, which was covered with sand, a temporary channel for the use of boats was dredged around the rock, requiring the removal of 7,674 cubic yards of material.

New Baltimore and Stone Light (Van Wies) bars.—A very low stage of water prevailed in October, 1891, and vessels had great difficulty in getting through the east channel opposite New Baltimore, and also past Stone Light, just above Van Wies Point, where several boats grounded. To relieve navigation at these points open-market agreements at previous contract rates were made with P. W. Myers, dated October 30, 1891, for the removal of 5,000 cubic yards of material from east channel, New Baltimore, and with E. M. Payn & Co., same date, for the removal of 2,821 cubic yards at Stone Light. This dredging was completed November 21, 1891, and was of the greatest relief to navigation, which suffered no further detentions at this point during the season.

WRECKS.

During the fiscal year wrecks were removed from the river at the following points: Opposite lower end of Cuylers Island; at north end of Coeymans Middle Dike. These wrecks, which were old canal barges, were broken up and removed by a dredge, and the fragments placed where they could not be washed back into the river.

REMOVAL OF ROCKS BY SUBMARINE BLASTING.

Dettinger Rock.—The work of removing the rock in the channel just below Van Wies Point and opposite Dettinger's dock, which was in progress at the end of the last fiscal year, was continued to completion, August 1, 1891. This work was done by hired labor and the use of the United States drill scow *Hudson*. A force of 13 men was employed, including a foreman and a diver. The holes were drilled from the platform of the drill scow, by steam drills, and were carried to at least 2 feet below the required depth to which the rock was to be removed, namely, 12 feet below mean low water. After drilling from 15 to 20 holes they were all charged with forcite, in tin cans, and then simultaneously exploded by electric battery. In this way the whole area was drilled and blasted over, and the rock thoroughly broken up. A dredge was next employed, and the broken rock removed. The rock, which is a shale, was readily broken up. It was found necessary, however, to use a quick powder, and the No. 2 forcite of the American Forcite Powder Manufacturing Company was used with good effect. The rock was removed to a depth of 12 feet at mean low water, at a total cost of $5,062.27; area blasted over, 7,528 square feet; number of holes drilled, 727; average depth of hole, 3.8 feet; estimated rock in place, 300 cubic yards; cost per cubic yard of rock in place, $16.87; 800 cubic yards, scow measurement, broken rock removed by dredge, cost per cubic yard, scow measurement, $6.33.

Overslaugh Rock.—On the complete removal of Dettinger Rock, the drill scow was moved to Overslaugh Rock, which lies in the channel 120 feet east of Overslaugh Dike and 1,900 feet above Stone Light, Van Wies Point.

Work of drilling and blasting was begun August 8, 1891, and continued until November 24, 1891, when, on account of cold weather, work was suspended for the season. A dredge was then engaged and 572 cubic yards of broken rock removed. Two-thirds of the area was blasted over and the rock removed to a depth of 12 feet, mean low water. This rock is a similar formation to the one removed opposite Dettinger's dock. It covers an area 300 feet long by 55 feet wide, its length being in the direction of the channel, and its highest point being 120 feet east of Overslaugh Dike No. 2. It is almost entirely covered with sand to a depth of 2 feet, approximately, and much difficulty is encountered in charging the holes for explosion, on account of the constant downstream movement of the sand along the bottom, which fills the holes as rapidly as they are drilled. Work is now in progress, and it is expected that the rock will be wholly removed during the month of August.

HIRED LABOR.

Besides the hired labor employed on the drill scow, a foreman and 25 men were employed during the season of 1891 repaving the Overslaugh Dikes Nos. 1 and 2. This work was in progress at the end of the last fiscal year, and was completed December 10, 1891. During this spring a foreman and 6 men were employed repairing in a similar way the paving at Patroon Lower Island.

The revetted slopes at these points are now in excellent condition, and, should no unforeseen accident happen, will need no further repairs for several years.

The permanent works remaining to be built to complete the improvement as originally projected are:

(1) Completion of dike from Staats Island to Campbell Island.
(2) Completion of dike from Schermerhorn Island to Shad Island.
(3) Improvement at Willow Island.

The cost of these works is estimated at $90,000.

The river and harbor act of September 19, 1890, provided for the examination of the obstructions to navigation in the Hudson River between New York City and the State Dam at Troy, N. Y., and the formation of a project and estimate of cost of widening and deepening the river for the navigation of seagoing vessels drawing 20 feet of water, and a separate project and estimate of cost for improving the river between Coxsackie and the State Dam at Troy to such an extent as to secure a navigable channel 12 feet deep, mean low water.

The surveys required by the Board appointed by the Secretary of War were assigned to Mr. Charles G. Weir, assistant engineer, who completed satisfactorily his duty in connection therewith in September, enabling the report called for by the act to be submitted to the Chief of Engineers October 1, 1891.

The Board of Engineers by whom this question was examined recommended that the regulating works contemplated in the project of 1867 be completed and maintained; that additional regulating works be constructed below New Baltimore, and that the river be deepened by dredging so as to provide a navigable channel 12 feet deep, mean low water, between Coxsackie and the State Dam at Troy.

At the close of the last fiscal year the amount required to be appropriated to complete the project of 1867 was $145,000. This sum is not sufficient to meet the annual expenditures for improvements provided in the new project, and the explanation is here made that the recommendation in regard to the next appropriation for continuing this improvement is based on the assumption that the new project is sanctioned by Congress.

GENERAL REMARKS.

The navigable condition of that portion of the Hudson River under improvement is better than ever before, and general satisfaction seems to have been given by the character and thoroughness of the work done by the Government during the past year. The new dikes were thoroughly built, and will have an important bearing on the future maintenance of the channels. With the exception of two places, the shores are well protected against erosion.

At Breaker Island, just below Troy, where the river is very narrow, material is washed from the banks into the channel every year by the freshet erosions. If part of this island be cut away to give freer egress to the water, and a bulkhead be built along the front for a distance of 1,500 feet to prevent further erosion, much of the trouble at this point will disappear.

For a distance of 1,500 feet north from Roah Hook, along the west bank of the river, the currents have cut into the shore, causing it to recede, and the abraded material has been carried into the channel. It is probable that a dike may be necessary to arrest further deterioration of the shore at this point.

The repairs to the dikes enumerated in the last annual report have either been completed or are now in progress, with the exception of the repairs to Base Island and Small Island dikes, which have been abandoned for the present on account of the urgency of concentrating efforts on the repairs to Patroon Lower Island Crib Dike. The repairs to these dikes are necessary and should be made when funds are available. Aside from these, the Port Schuyler Dike needs some slight repair where the paving has been torn up by ice.

A stretch of 700 feet of Overslaugh Dike Nos. 1 and 2 should also be repaved where the old paving has been destroyed. Some slight repairs should also be made to the Cedar Hill Dike, between Poplar and Schermerhorn islands, where the dike has been damaged by the ice.

Barren Island Dike requires repairs additional to those made in 1889 (Annual Report Chief of Engineers, 1890, page 693). The repairs then made were designed to hold the old work together until work of a more permanent character could be made as opportunity offered and funds became available.

The dredging done by the Government during the fiscal year has been of very material benefit to navigation. Only those bars have been improved which gave obstruction to navigation, and the lines of dredging were laid out with reference to economy of work and to the necessities of commerce.

The legislature of the State of New York, during its last session, appropriated $35,000 for dredging in the Hudson River, part to be applied toward excavating a channel from the steamboat wharf at Stuyvesant to deep water in the Hudson, and part toward deepening channel between Coeymans Dike and the Middle Dike at Coeymans.

The authority of the Secretary of War was first obtained for altering the condition and capacity of the channels, in compliance with section 7 of the river and harbor act of September 19, 1890, and the State authorities submitted plans of the proposed work to the engineer officer in charge before contracts were made. The dredging provided by these contracts comprises 8,000 cubic yards at Wilbur's Ice House, Bath; 4,000 cubic yards above Upper Railroad Bridge, Albany; and 37,000 cubic yards at Stuyvesant.

While the dredgemasters on the river at first considered the river and harbor act of September 19, 1890, as somewhat severe in regard to dredging and dumping, they have never ceased to comply strictly with its requirements, and in turn the engineer officer has never withheld approval of any application for authority to dredge in the navigable waters of the river, unless the granting of such application would be manifestly injurious to the river.

The representatives of the Government and of the State now work together without strained relations, and the good results of this harmony of action are shown in the excellent navigable condition of the river.

The amount expended during the fiscal year ending June 30, 1892, inclusive of outstanding liabilities, was $96,962.43.

An appropriation of $500,000 is recommended, to be applied towards the commencement of the new project.

The improvement has been under the local charge of Mr. Charles G. Weir, assistant engineer, who has well and faithfully discharged the duties assigned to him.

This work is in the collection district of New York, Albany being a port of entry.

Amounts appropriated.

By act of Congress approved—	
June 30, 1834	$70,000
July 2, 1836	100,000
March 3, 1837	100,000
July 7, 1838	100,000
August 30, 1852	50,000
	420,000

Amounts appropriated for present project.

By act of Congress approved—	
June 26, 1864, allotment	$33,000.00
June 23, 1866	50,000.00
March 3, 1867	305,188.00
July 25, 1868	85,000.00
April 10, 1869	89,100.00
July 11, 1870	40,000.00
March 3, 1871	40,000.00
June 10, 1872	40,000.00
March 3, 1873	40,000.00
June 23, 1874	40,000.00

By act of Congress approved—Continued.	
March 3, 1875	$40,000.00
August 14, 1876	50,000.00
June 18, 1878	70,000.00
March 3, 1879	30,000.00
June 14, 1880	20,000.00
March 3, 1881	15,000.00
By act of Congress passed August 2, 1882	10,000.00
By act of Congress approved—	
July 5, 1884	30,000.00
August 5, 1886	26,250.00
August 11, 1888	75,000.00
September 19, 1890	150,000.00
Total	1,278,538.00
Received from other sources	792.57
	1,279,330.57
Amount expended to June 30, 1892, inclusive of outstanding liabilities	1,247,940.29

Money statement.

July 1, 1891, balance unexpended		$128,342.71
June 30, 1892, amount expended during fiscal year		87,228.98
July 1, 1892, balance unexpended		41,113.73
July 1, 1892, outstanding liabilities	$9,733.45	
July 1, 1892, amount covered by uncompleted contracts	11,246.75	
		20,980.20
July 1, 1892, balance available		20,133.53
Amount appropriated by act approved July 13, 1892		187,500.00
Amount available for fiscal year ending June 30, 1893		207,633.53
Amount (estimated) required for completion of existing project		2,260,406.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

COMMERCIAL STATISTICS.

The information contained in the report made in 1890 on the commercial statistics of the Hudson River, by Mr. Charles G. Weir, assistant engineer, was so complete that it is deemed best to repeat it in the report for this year.

The importance of the Hudson as a great waterway of commerce is apparent when it is known that aside from its own local traffic, which in itself is very large, it absorbs all the traffic of the Erie, Champlain, and Delaware and Hudson canals, besides the great coal trade of the Pennsylvania Coal Company at Newburg, and the Erie coal trade at Piermont. The average season of navigation of the river is 240 days and that of the canals 220 days.

The Erie Canal, extending from Albany to Buffalo, on Lake Erie, a distance of 352 miles, with a difference of level of 577 feet, and to Oswego, on Lake Ontario, connects the Great Northern Lakes with the Hudson River, and brings in immense commerce from the Northwest and Canada. The principal items of this commerce are lumber and grain.

The Champlain Canal, 69 miles long, connects Lake Champlain with the Hudson River. This lake, which is 93 feet above tide of the Hudson, and whose waters flow into the St. Lawrence, is connected by the Chambly Canal with the St. Lawrence River below Montreal. The principal items of tonnage on this canal are lumber and iron ore. The above canals, with 575 miles of subsidiaries, constitute the New York State canals. The Erie Canal enters the Hudson by three tide-water locks, one at the foot of Twenty-third street, West Troy; one at the foot of Eighth street, West Troy, and a third at the lumber district, Albany

The Champlain Canal enters the river at Waterford, 3 miles above the State Dam, and boats are locked through the dam to tide water. It is also connected with the Erie Canal and, through its tide-water locks, with the Hudson River.

The Delaware and Hudson Canal enters the Hudson through Rondout Creek at Rondout, N. Y., and brings the anthracite coal country at Honesdale and the Delaware River into water communication with the Hudson. The principal items of tonnage on this canal are coal, blue stone, and cement. Aside from the above feeders to the commerce of the Hudson, the Pennsylvania Coal Company has a large tide-water coal depot at Newburg where also the Erie Railroad has a terminal point and transfers large quantities of freight by boat across the river. The Erie Railroad also has a coal depot at Piermont, 20 miles above New York, where preparations are being made to handle a very large supply.

The following statistics include the tonnage received at all points above Spuyten Duyvil Creek, and of the local shipment between points on the river; only that shipped is credited to the points from which it was shipped, no entry being made to the total tonnage of the amount received at local points from other local points. The total tonnage also includes all through freight shipped from points up the river that passed the mouth of Spuyten Duyvil Creek going south.

The two principal industries on the river which add materially to the total tonnage are ice and brick. The capacity of the ice houses on and adjacent to the river exceeds 4,000,000 tons, and amount generally harvested 3,500,000. The brick manufactured on the river exceed 850,000,000.

Total tonnage of all shipping points on the Hudson River during 1889, not including the tonnage coming through State canals........tons..	15,033,309
Value of same..	$378,196,094
Total tonnage coming to and leaving tide water through State canals, 1889...tons..	3,592,437
Value of same..	$108,000,000
Increase of same over tonnage, 1888..........................tons..	326,466
Grand total tonnage of the Hudson River, including the tonnage through State canals..tons..	18,582,596
Value of same..	$485,733,094

This does not include the value of vessels carrying the above trade, which are equally exposed to the dangers of navigation.

Number of transportation companies for passengers or freight, not including steamboats or pleasure boats..........................	30
Total number of passengers carried, 1889..........................	5,000,000
Total population along the river..................................	450,000

Commercial statistics of the port of Albany, N. Y., from July 1, 1891, to June 1, 1892.

Amount of revenue collected..	$203,716.81
Value of all imports..	670,481.00
American vessels from foreign ports:	
Number..	215
Registered tonnage..	20,425.47

Statement of the number and tonnage of all vessels belonging to the port of Albany, N. Y., June 1, 1892.

Class.	Number.	Registered tonnage.
Steam vessels..	180	29,963.68
Sailing vessels..	35	1,997.52
Barges..	72	14,107.29
Canal boats..	208	20,824.60

Chap. 281.—AN ACT to incorporate the Albany and Bath-on-the-Hudson Bridge Company, and to authorize the construction of a bridge across the Hudson River at the city of Albany, and appurtenances and approaches to said bridge.

[Approved by the governor April 11, 1892. Passed, three-fifths being present.]

The people of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. Edward A. Maher, Francis B. Delehanty, and Henry Bronk, of the city of Albany; Amos H. Tyler and John H. Dearstyne, of the village of Bath-on-the-Hudson; Oscar F. Hilt, of the village of Greenbush; John Bogart, Walter C. Foster, and Henry B. Hammond, of the city of New York, and their associates and successors, are hereby created and constituted a body politic and corporate by the name and style of the "Albany and Bath-on-the-Hudson Bridge Company," for the purpose of constructing and maintaining a permanent toll bridge and appurtenances and avenues of approach thereto for travel and transportation across the Hudson River from North Ferry street, on the westerly side or shore of said river, in said city of Albany, to Tracy street on the opposite side or shore of said river, in the said village of Bath-on-the-Hudson in said county of Rensselaer, and as such corporation they are invested with all the powers and privileges and are subject to all liabilities conferred and imposed by the general corporation law of the State of New York.

2. The capital stock of said corporation shall be three hundred thousand dollars, divided into shares of one hundred dollars each. The directors of such corporation may at any time and after due notice, with the consent in writing of stockholders holding a majority of the stock, increase such capital. The said shares shall be deemed personal property, and shall be transferable upon the books of the corporation in such manner as shall be prescribed by the by-laws of said corporation.

3. The persons named in the first section of this act shall constitute the first board of directors of the corporation hereby created, and shall hold their places as such until the first Monday in May, eighteen hundred and ninety-three, and until others are elected in their stead. Within ninety days after the passage of this act, the said persons, or a majority of them, shall give ten days' public notice, by publishing in a daily newspaper of the city of Albany, of a time and place when they will receive subscriptions to the capital stock of said corporation, under such regulations as may be prescribed by them. They shall open books for that purpose, and shall keep the same open during the business hours of the day, and at the time and place named in the notice they shall receive subscriptions to the said capital stock. They shall issue stock in proper form to the subscribers therefor. In case of an excess of subscriptions, the said directors shall apportion the stock among the subscribers in such manner as they shall deem most likely to promote the interests of the corporation and the speedy erection of said bridge. At the time of subscribing, five dollars shall be paid on each share subscribed for, or the subscription shall not be received. Any corporation may subscribe to and become the owner with like rights as individuals of any part of the said capital stock not exceeding twenty per centum thereof.

4. The said corporation shall have power to purchase, acquire, hold, and use as much real estate as may be necessary for the site of said bridge, and of all piers, abutments, walls, and toll-houses to be connected therewith, and for the opening and maintaining of proper and necessary avenues of approach to and from the termini of said bridge. The said corporation shall also have power to mortgage its corporate property and franchises to secure the payment of any debt contracted by such corporation for the purposes mentioned in this act, and in case of the destruction of said bridge to reconstruct the same, and in like manner to borrow additional moneys for that purpose; but nothing herein contained shall authorize said corporation to borrow an amount exceeding its capital stock.

5. The board of directors shall have power to cause such examinations and surveys to be made as may be necessary in the erection of said bridge and the buildings, structures, and avenues of approach thereto, herein authorized, and for such purpose may appoint agents, who are authorized to enter upon the lands of any person, subject to responsibility for damages they may do thereto.

6. The annual election of directors of said corporation shall be held on the first Monday in May of each year, beginning with the year eighteen hundred and ninety-three, at such place in the city of Albany as the board of directors shall name. The directors shall be fifteen in number, and shall be selected from the stockholders of said corporation. Public notice of the election shall be given through a daily paper of the city of Albany, for at least ten days prior to such election. The persons elected by a majority of the shares voted upon the stockholders, in person or by proxy, shall constitute the directors for the then ensuing year and until others shall be elected in their places; and in case it shall happen at any time that the election of directors shall not be made on the day herein designated, it shall be lawful to hold such election on some day thereafter, on full and reasonable notice to the stockholders. The directors shall appoint one of their number as president of the said corporation, and they may also appoint such other officers and such agents as they may deem necessary from time to time. They shall have power to make, adopt, and amend such by-laws and rules as they deem proper for the interests of the corporation, and may prescribe such measures as will promote the speedy construction of the said bridge. All vacancies occurring in the board of directors, by death, resignation, or otherwise, shall be filled by the board for the balance of the term vacated. A majority of the board shall constitute a quorum for the transaction of business. The directors elected at the first election under the provisions of this section shall take the places of the incorporators named in the first section of this act.

7. The board of directors may require payment of the moneys remaining unpaid on the stock of the corporation, giving at least ten days' previous notice through a daily paper of the city of Albany, under penalty, in case of nonpayment, of forfeiture of said stock and all previous payments made thereon for the benefit of the said corporation.

8. The framework of the bridge which said corporation is authorized to erect shall be constructed of iron, upon stone piers, and shall be at a location of not less than twenty feet above ordinary tide water. There shall be a draw thereon which shall be of a width sufficient to allow of two openings thereon, each of not less than one hundred and fifty feet in width, and such draw shall be promptly opened to any vessel requiring the same on signal, without charge, and so as not to cause delay or hindrance to such vessels. From sundown to sunrise, during the season of navigation, suitable light shall be mounted upon such bridge to guide vessels approaching the draw, and the company shall be liable to owners of any vessels, or of the cargo thereof, for all damages which they may sustain by reason of any neglect in this respect. Said corporation is authorized to erect and maintain piers of masonry in the Hudson River, if necessary for the bridge, but said piers, other than the draw-piers, shall not be less than one hundred and fifty feet from center to center. The bridge shall be so constructed as to provide sufficient accommodations for pedestrians and vehicles, and rails may be laid thereon, and on the avenues of approach thereto, for the passage of cars drawn by animal power, or propelled by electric, steam, or other power, in such manner as the directors may deem proper, and under such terms and for such compensation as may be agreed upon between the company and any person or corporation, *Provided, however,* That the incline or grade approach to said bridge on the Albany side shall not extend across or beyond the east line of Water street in Albany. The said bridge shall be completed for use within three years from the date of the approval of the plan thereof by the Federal authorities, excluding any necessary or unavoidable delays arising from the pendency of legal proceedings against the company. Unless the construction of said bridge shall be commenced within one year after the date of the said approval by the Federal authorities all the rights and franchises hereby granted shall cease and determine.

9. Before constructing any such bridge or any appurtenances or avenues of approach thereto, the said corporation shall make a map and profile of the same as intended to be adopted, and shall cause the same to be certified by its president and filed in the offices of the county clerk of the counties of Albany and Rensselaer respectively.

10. When the said bridge shall be completed, the said corporation may erect toll-gates and fix rates of toll for persons, animals, horse cars, and vehicles of every kind and description drawn by animals or propelled by steam, electricity, or other motive power, entering upon or crossing over the said bridge and such structures as the said corporation may erect to grade the said bridge and the avenues and approaches thereto, but no greater rates of toll shall be charged for crossing the said bridge than were charged during the preceding month on the Albany and Greenbush Bridge over the Hudson River, now located at Albany, for persons, animals, and vehicles of the same kind and description. The rate of toll shall be posted conspicuously at each end of said bridge, and, at the option of the corporation, such toll shall be collected and paid before entering upon such bridge. If any person shall force or attempt to force a passage upon or over the said bridge without having paid the established toll he shall be deemed guilty of misdemeanor and shall also forfeit and pay to said corporation five times the amount of legal toll, to be recovered in the name of the corporation, with costs of suit.

11. If the said corporation shall, for any reason, be unable to agree with the owner or owners of any real estate required by it, for the purchase of said real estate, it shall have the right to acquire the same in the manner and by the proceedings authorized and provided for obtaining title to real estate in and by chapter ninety-five of the laws of eighteen hundred and ninety, entitled "An act to amend the code of civil procedure, being the general condemnation law and law for sale of corporate real property," and the provisions of said act shall, for that purpose, be considered applicable to the corporation hereby created, and the said corporation shall be entitled to avail itself of all the rights, privileges, and benefits conferred in and by said act. The said corporation shall be invested with the fee-simple of any title thus acquired.

12. Any person willfully doing injury to said bridge or any of its appurtenances or avenues of approach, either before or after their completion, shall forfeit and pay to the said corporation three times the amount of such injury and shall be deemed guilty of a felony, punishable by a fine of not less than one thousand dollars or imprisonment for a term of not less than one nor more than three years, or by both such fine and imprisonment, in the discretion of the court. Concurrent jurisdiction shall be possessed and exercised by the courts in the counties in which said bridge, or any part thereof, or its appurtenances or approaches may be respectively located, over all crimes committed to or on the same, and all civil actions or proceedings prosecuted by the said corporation.

13. The said corporation is authorized to put upon the said bridge a notice forbidding persons from crossing the same with any horse car or vehicle faster than a walk, and in case any person shall cross said bridge in violation of said notice he shall forfeit and pay to the said corporation the sum of one dollar for every such offense, to be recovered in the name of the corporation, with costs of suit.

14. The said corporation shall not suffer any bars or obstruction which may be formed by reason of the said bridge or the piers thereof, to remain in the river so as at any time to hinder or impede the free navigation thereof, and for any willful neglect in this respect said corporation shall be liable to a penalty of five hundred dollars to the people of the State, and also pay to the party aggrieved or injured thereby such damage as he may have sustained.

15. The persons first named in this act, or a majority of them, shall call a meeting of the directors or incorporators herein named at some convenient time and place, of which due notice shall be given at as early a day after the passage of this act as may be practicable, and shall then organize for the transaction of business, pursuant to this act.

16. It shall be the duty of the corporation organized under this act in the construction and maintenance of its bridge, abutments, and approaches to guard and protect the property of the village of Bath-on-the-Hudson affected by said construction, and to hold said village free from all damages to streets and sewers by reason of said construction.

17. This act shall take effect immediately.

REPORTS ON IMPROVEMENT OF HUDSON RIVER, NEW YORK, MADE IN COMPLIANCE WITH PROVISIONS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

[Printed in House Ex. Doc. No. 23, Fifty-second Congress, first session.]

WAR DEPARTMENT,
Washington, December 8, 1891.

SIR: I have the honor to transmit herewith a letter from the Chief of Engineers, dated November 20, 1891, together with a copy of report of a Board of Engineer Officers, dated October 1, 1891, appointed in compliance with the provisions of the river and harbor act of September 19, 1890, to—

> thoroughly examine the obstructions to navigation in the Hudson River, between New York City and the State dam at Troy, New York, and report a project and estimate of the cost of widening and deepening said river between New York City and the city of Albany, and also between New York City and the State dam at the city of Troy, for the navigation of seagoing vessels drawing 20 feet of water, and also a separate estimate of the expense of improving the river between Coxsackie and the State dam at Troy, to such an extent as to secure a navigable channel 12 feet deep at mean low water.

The views expressed in the report of the Board are concurred in by the Chief of Engineers and by this Department.

Very respectfully,

L. A. GRANT,
Acting Secretary of War.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

LETTER OF THE CHIEF OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., November 20, 1891.

SIR: The river and harbor act approved September 19, 1890, provides as follows:

> That the Secretary of War is authorized and directed to appoint a board of three officers of the Corps of Engineers, United States Army, whose duty it will be to thoroughly examine the obstructions to navigation in the Hudson River, between New York City and the State dam at Troy, New York, and report a project and estimate of the cost of widening and deepening said river between New York City and the city of Albany, and also between New York City and the State dam at the city of Troy for the navigation of sea-going vessels drawing 20 feet of water, and also a separate estimate of the expense of improving the river between Coxsackie and the State dam at Troy, to such an extent as to secure a navigable channel 12 feet deep at mean low water. Said Board shall accompany their report with a statement as to the usefulness of such improvements and of their relations and value to commerce, and of the advisability of entering upon the same at this time; and the Secretary of War shall transmit said reports to Congress with his own views and those of the Chief of Engineers, United States Army, thereon, and the expenses of said Board shall be paid out of the appropriation made in this act for the improvement of the Hudson River, not to exceed $10,000.

The Board of Engineers authorized and directed by the above law has completed the duty assigned it, and I have now the honor to submit the accompanying copy of its report dated October 1, 1891.

Three propositions looking to improvement of the navigation of the river were by the terms of the act to be considered by the Board and projects with estimates of cost required to be submitted.

1. Between New York City and the city of Albany, for the navigation of sea-going vessels drawing 20 feet of water.
2. Between New York City and the State dam at Troy, for the navigation of sea-going vessels drawing 20 feet of water.
3. Between Coxsackie and the State dam at Troy, for navigable channel 12 feet deep at mean low water.

Upon these three several propositions, the Board, after full and careful consideration, remarks as follows:

Concerning the first two—deep channels between New York City and Albany and between New York City and Troy—

> The Board is of the opinion that the possible benefits to commerce to be derived from the proposed improvement for vessels drawing 20 feet are not, under existing conditions, sufficient to justify at this time the expenditure necessary to make such improvement.
>
> * * * * * * *
>
> The estimates of cost of carrying out the two projects contained in the said act, which provide for widening and deepening the channels between New York City and the city of Albany and between New York City and the city of Troy, for the navigation of sea-going vessels drawing 20 feet of water, are $5,934,847.60 and $19,507,832.74, respectively.

Concerning the third—channel 12 feet deep between Coxsackie and the State dam at Troy—

> After carefully studying the wants of commerce, the Board is of the opinion that the third project contained in the act of September 19, 1890, which provides for improving the Hudson River "between Coxsackie and the State dam at Troy to such an extent as to secure a navigable channel 12 feet deep at mean low water," is a worthy and useful one, and accordingly recommends it for adoption.
>
> * * * * * * *
>
> In view of the necessities of the commerce incident to the river proper and its tributary country, the Board is of the opinion that the project for improvement adopted in 1867 should be extended so as to provide for a channel depth of at least 12 feet at mean low water, and that such an extension is well worth the expenditure required for its execution.

The estimate submitted by the Board for a channel 12 feet deep and 400 feet wide from Coxsackie to the foot of Broadway, Troy, and thence 12 feet deep and 300 feet wide to the State dam at Troy is $2,447,906.56.

I concur in the views of the Board.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF BOARD OF ENGINEERS CONSTITUTED IN COMPLIANCE WITH ACT APPROVED SEPTEMBER 19, 1890.

UNITED STATES ENGINEER OFFICE,
New York, N. Y., October 1, 1891.

GENERAL: The Board of Engineers constituted by Special Orders No. 66, Headquarters, Corps of Engineers, September 30, 1890, has the honor to submit the following report upon the improvement of the Hudson River, New York, to comply with the requirements of the river and harbor act of September 19, 1890.

The special duty required of the Board, in the language of the act, was:

> To thoroughly examine the obstructions to navigation in the Hudson River, between New York City and the State Dam at Troy, N. Y., and report a project and estimate of the cost of widening and deepening said river between New York City and the city of Albany, and also between New York City and the State Dam at the city of Troy for the navigation of sea-going vessels drawing 20 feet of water, and also a separate estimate of the expense of improving the river between Coxsackie and the State Dam at Troy, to such an extent as to secure a navigable channel 12 feet deep at mean low water. Said Board shall accompany their report with a statement as to the usefulness of such improvements, and of their relations and value to commerce, and of the advisability of entering upon the same at this time; and the Secretary of War shall transmit said reports to Congress with his own views and those of the Chief of Engineers, U. S. Army, thereon; and the expenses of said Board shall be paid out of the appropriation made in this act for the improvement of the Hudson River, not to exceed $10,000.

As all the obstructions to the navigation of the river above the plane of 20 feet mean low water are situated between Hudson and Troy, the duties of the Board were confined to the consideration of the improvement of that reach. The river between those points was accordingly examined thoroughly by the Board in person, and a careful study has been made of all accessible charts which have been published.

To enable the Board to confer with all persons whose interests might be affected by the enlarged improvement of the river, a public meeting was held at Albany, N. Y., January 6, 1891, at which the attendance was very large. A second meeting was held in New York, May 15, 1891, to enable the commercial bodies in that city not previously represented to present their views.

The information gathered at these meetings in regard to "the usefulness of the improvements and of their relations and value to commerce and of the advisability of entering upon the same at this time" was all reduced to writing, and copies are appended hereto.

The improvement of the Hudson River by the State authorities antedates the present century, but the part which the General Government has taken in it dates only from 1834, at which time the first appropriation, amounting to $70,000, was made.

A Board of United States Engineers, convened in that year, prepared a project for improvement which contemplated the construction of lines of longitudinal dikes from Troy to New Baltimore, supplemented by the use of the dredge.

The State of New York had previously followed plans of improvement which provided for the application of groins or jetties for contracting channel to induce scour.

Under the general system adopted by the United States operations for the construction of longitudinal dikes and for occasional dredging were carried on during the years 1835, 1836, 1837, and 1838. A suspension of work then occurred, and active operations on an extensive scale were not resumed until 1867, when work under the project prepared by the officer then in local charge was begun.

In the meanwhile the State of New York, in 1863, had taken up the improvement on the general plan adopted by the United States in 1834, and between 1863 and 1867 six longitudinal dikes were built on the left bank, extending from Houghtailing Island to Albany. The Annual Reports of the Chief of Engineers during the past few years show that the improvement by the construction of dikes has been left almost exclusively to the General Government, and that by dredging to the State of New York.

The existing plans of improvement, adopted in 1867, provide for securing a navigable channel 11 feet deep at mean low water from New Baltimore to Albany, and 9 feet deep at mean low water from Albany to Troy, at an estimated cost of $862,297.75. This estimate was revised and increased several times at later periods to take account of expenditures for repairs and for work done not included in previous estimates, and the estimate of final cost, according to the revision of 1889, is $1,424,435.

The dikes as built are in general pile dikes, single or double, and are revetted or filled with broken stone.

The total amount appropriated since 1864 is $1,279,330.57, and the amount expended to June 30, 1891, is $1,162,011.70.

The estimated amount required to be appropriated to complete the existing project is $145,000. It therefore appears that new estimates are essential at this time, in order that the improvement of the river may continue without interruption.

The following is a description of the plan now in process of execution:

First.—A system of longitudinal dikes to confine the current sufficiently to allow the ebb and flow of the tidal current to keep the channel clear; these dikes to be gradually brought nearer together from New Baltimore towards Troy, so as to assist the entrance of the flood current and increase its height, their height to be kept approximately at the level of the tidal high water, so as not to confine the freshets, the exact level, however, being left to be determined by experience as the work progresses.

Second.—That the dredge be used, so far as necessary, to open the channels above described, which the current should not be allowed to do, except very gradually, lest accumulations dangerous to navigation be formed below.

Third.—Keeping, as far as practicable, the side reservoirs open to the passage of tidal currents by gaps at their lower extremities, in order to increase the tidal flow.

Fourth.—Dumping all dredged material in secure places, where it can not be moved back again into the channel by the current.

Fifth.—Constructing the dikes of timber and stone, in a manner to secure their permanency, at a minimum cost, the details varying with the locality, to be left to the discretion of the local engineer, to be so designed as to admit of having an increased height given to the dikes if necessary.

Sixth.—To protect, when necessary, the banks and islands against the abrading action of the currents by revetments.

Seventh.—That limits, beyond which no encroachments upon the channels should be made, be prescribed, and that any such encroachments be reported to the engineer in charge.

The width between the projected dikes built to revet the banks as well as to contract the water way varies from the minimum of 575 feet at Troy to the maximum of 1,200 feet at New Baltimore. The average width between Albany and New Baltimore is 800 feet, approximately.

During the time the improvement has been in progress certain facts in regard to the physics of the river have been gathered by the officers in local charge, which have been reported from time to time in annual reports to the Chief of Engineers, and in special reports by the assistants to the officer in charge, which form part of the files of the main office.

So far as practicable, the records have been carefully searched for this important information, and supplementary examinations have been made upon the river itself since the passage of the river and harbor act of September 19, 1890, especially by borings to determine the nature of the river bottom from the city of Hudson to the State Dam at Troy.

The general features of the river basins, and the special characteristics of the main river obtained from these sources, will now be stated before submitting the projects and estimates required of the Board to comply with the first part of its instructions.

PHYSICS OF THE HUDSON RIVER.

Drainage areas.—The Hudson River has its source in fourteen small lakes in the Adirondack Mountains of northern New York, near Newcomb, Essex County, which are 200 feet above tide water and have an aggregate water area of 6,000 acres. The length of the river from the sources to Fort Edward is 109 miles, and the drainage area to that point is 2,300 square miles. The distance from Fort Edward to the State Dam at Troy is 40 miles, and the difference of level between them is 108½ feet. The height of the dam being 9½ feet, the total difference of level between Fort Edward and tide water is 118 feet.

There is no river slope in the upper section corresponding to the actual fall, for the river is crossed by frequent dams, and is made up of a succession of reaches of different levels.

The drainage area of the lower section, below Fort Edward, is 2,075 square miles, making the total drainage area of the river above the State Dam at Troy, exclusive of the Mohawk Valley, 4,375 square miles, or 2,800,000 acres.

The Mohawk rises in the northwestern part of the State, and after flowing eastward for a distance of 150 miles joins the Hudson at Troy by several mouths. It drains an area of 2,800 square miles, or 1,814,000 acres, so that the total drainage area of the Hudson River to Troy is 7,200 square miles, or 4,614,000 acres.

The greater part of the material carried in suspension in the Hudson River above Albany is believed to come from the Mohawk River and its tributary, the Schoharie River, while the sands and gravel that form the heavy and obstinate bars near Albany, and chiefly between Albany and Troy, have come from the Upper Hudson. Since the construction of the State Dam at Troy it is probable that the shoal bars above Albany are derived principally from the degradation of the banks of the river at all points, due to current action during freshets and to wash of waves created by passing steamers.

Rainfall and water supply.—The average rainfall during the past sixty-three years, from observations recorded in the report of the water commissioner at Troy for 1889, is 36.55 inches. The greatest rainfall in any year was in 1878, when the record was 49.23 inches; and the least rainfall in 1839, when the record was 18.32 inches.

The greatest rainfall in any one month was 13.8 inches, recorded in October, 1869, and the least rainfall, 0.2 inch, recorded in May, 1840.

Generally speaking, the effects of rain storms are shown by a rise in the river within twenty-four hours after the first rainfall.

At times during the dry season of nearly every year no water flows over the State Dam at Troy for a month at least, and, excepting the lockage water of the canals and the leakage through gates, there is during that period little apparent fresh-water supply from the upper river to the flow of the river below.

From this, and from the fact that the tide has a range of 1 foot, approximately, at the State Dam, it is evident that the navigation of the Hudson River below the dam is dependent in a large degree, at the low stage, upon tidal flow.

Freshets.—Freshets in the Mohawk River are severe, but of short duration, and are more frequent than in the Hudson.

The height of the greatest known freshet in the Hudson River, due to rainfall alone, above the plane of mean low water at Albany, where the width between banks is 850 to 1,000 feet, occurred in October, 1869, when the rise was 19 feet, due to a rainfall in that month of 13.8 inches.

The highest known rise, of 22 feet, at Albany, occurring in February, 1857, was due to an ice gorge at Van Wies Point, and it is to be remarked that during the same month the rise at Fort Edward was 18 feet, at Waterford 15 feet, and at the State Dam, Troy, 13 feet.

At Albany the heights of the spring freshets generally range from 6 feet to 8 feet above ordinary water level, but occasionally the waters rise 5 to 6 feet higher when the river opens rapidly, or when ice jams have been formed in front of or immediately below the city.

If the change from winter to spring is rapid, the freshets are violent but of short duration; but if the change is gradual, the river swells slowly, and slowly subsides, and the waters remain high through the spring and well into the summer.

In midwinter there is usually a period of mild weather called the "January thaw," during which there frequently occurs a partial rise in the river, soon checked by a return of cold weather. It is then that ice dams are usually formed, which last until the spring opens.

The greatest rises may be expected after severe rains in the spring, when the ground is frozen and the drainage free, or in the autumn.

The effect of the freshets is to produce unusual scour in contracted channels and on soft bottoms, and to deposit the abraded materials at the points where the cross section becomes enlarged.

The project of 1834 proposed to utilize the agency of freshets in opening a channel across the bars for the maintenance of the navigable water way by making the dikes high, but later projects for the improvement of the river are based upon the principle that freshets are detrimental as well as beneficial to the river, for the reason that they create irregularities in the regimen and bring about irregular scours and deposits, and in accordance with this principle the dikes provided for in the project for improvement adopted in 1867 do not rise above the plane of tidal high water.

The greatest velocity of flow corresponds to the highest rise of water only when the river is unobstructed.

Tides and discharges.—The tidal information in possession of the Board comes from observations made prior to 1890.

The tidal observations made in the upper river in 1876, corrected in 1884, are represented in the following table:

The mean rise and fall of tides at—

	Feet.
State Dam, Troy, N. Y	0.80
Nail Works, Troy, N. Y	1.94
Albany, N. Y	2.32
Castleton, N. Y	2.53
New Baltimore, N. Y.	3.42
New York, Governors Island, from Coast Survey	4.40

The mean duration of rise of tides at Albany is five hours, and the mean duration of fall seven hours and twenty-five minutes.

The plane of mean low water at New York below that at—

	Feet.
New Baltimore	3.55
Castleton	4.35
Albany	4.78
Troy Nail Works	5.32
Troy State Dam	6.88

The State Dam at Troy is the dividing line between the tidal and non-tidal compartments of the river system. When there is little or no water passing over the dam at or near low stage, the lower river becomes largely tidal for a period not exceeding six weeks, and the alternating flood and ebb currents there are well defined in their proper direction. When the upper rivers discharge their average supply, the ebb current is well defined, but the flood currents can scarcely be noticed. In times of freshets tides are still to be observed, but there is no appreciable flood current in the upper river. The times of high and low water stands, corresponding to two successive tidal waves, are coincident at Governors Island and at the State Dam, Troy, N. Y. At Tivoli, the tidal phases are the converse of those at Governors Island and at the dam.

The tidal area from the dam to Albany measures 47,600,000 square feet, and the corresponding tidal prism for a mean rise of 1.68 feet over the whole area measures 79,968,000 cubic feet.

The area of the cross section at Albany, where the width between protected banks is 850 feet, approximately, is 10,000 square feet at mean low water, and the mean discharge at that time is 2,995 cubic feet, approximately, per second. Gaugings of the Mohawk and Upper Hudson rivers above the dam were made in October, 1874, and the mean fresh-water discharge for the combined rivers for that month was found to be 4,853 cubic feet per second.

The calculated mean discharge above the dam for that month, based on the monthly rainfall of 1.77 inches (one-half the average monthly fall for the year), and an assumed drainage of 0.48 inch, was 3,001.6 cubic feet per second. It is probable that the gaugings were made shortly after a rainfall when the river was slightly in freshet, and the resulting mean discharge for that month is somewhat large. But assuming the gaugings to be correct, the error will be slight if the mean fresh-water discharge for that month at Albany be taken at 5,000 cubic feet per second.

The calculated mean discharge of fresh water in 1874, at the Albany cross-section, based on the mean monthly rainfall for the entire year of 3.16 inches, and the assumed drainage of 1.67 inches, is found to be 10,703 cubic feet per second.

The information in regard to velocities at different stages is not conclusive, but observations show that moderate rises of 1 foot or more at Albany give surface velocities varying, during ebb, from 1 foot per second in the first quarter, to 2 feet in the last quarter. A freshet rise of 7 feet gives a velocity of 3 feet per second, and an 8-foot rise gives a velocity of 3¼ feet per second. It is reported also that the maximum rise does not give a velocity exceeding 6 feet per second.

The discharge of the Hudson between Troy and Albany at its lowest stage may be taken without great error at about 3,000 cubic feet per second. The river supply therefore during that stage is inadequate in the upper part of the river for scouring or for navigation, independent of tidal flow.

BARS.

The accompanying chart* of the Hudson River, prepared from the latest surveys, shows in detail the location of all the obstructive bars from Troy to Hudson.

The channel from Broadway, Troy, north to the State dam, is contracted by numerous islands, and is very narrow and shoal. The water here flows over a rocky bed, restricting commerce principally to the wharves which lie south of Broadway.

From Troy to Albany, while the maximum depth of 14 feet, mean low water, is noted in many places, the navigable depth is reduced to 7½ feet to 8 feet, mean low water, by six obstructing bars composed of coarse and fine gravel and coarse and fine sand. Several of the deep pools, between the bars, particularly at Troy, and opposite Breakers Island, have groups of large bowlders covering the bed.

The navigable depth in this reach before improvements were made was about 4 feet, mean low water.

At Albany the average depth is 11 feet to 12½ feet, mean low water, but the maximum depth is 16 feet, approximately.

From Albany to New Baltimore the depths are very variable, the prevailing depth being 10 feet and over, with pools of greater depth separated by long cross-over bars, over which the greatest depth does not exceed 9 to 10 feet. These bars are eight in number and are composed chiefly of fine sand. In this reach rock outcrops above the plane of 22 feet, mean low water, at the Overslaugh, Van Wies Point, and at Mulls, and before improvement the approximate navigable depth was only 7 feet, mean low water.

New Baltimore is the highest point on the river at which the depth of 20 feet, mean low water, is found, and from that place south to Hudson two points are observed where there is a less depth than 15 feet; one point is at Stonehouse Bar, where the least depth is 13 feet, mean low water, and the other at Four Mile Point, where the least depth is 14 feet, mean low water. These are bars of fine sand, and their formation has been the result of long action, though it is to be remarked that the shoaling at Stonehouse Bar has been more rapid of late years than formerly, owing possibly to the fact that the construction of contracting dikes above New Baltimore has induced an increased downstream movement of detritus to form bars in the spaces below New Baltimore, where the stream has not been confined by artificial works.

---

*Not reprinted; printed in House Ex. Doc. No. 23, Fifty-second Congress, first session.

BORINGS.

To ascertain the character of the formation underlying the bed of the river essential to the preparation of estimates for excavations extending to a plane 22 feet below mean low water, borings were taken along cross sections 1,000 feet apart from Troy to New Baltimore, and also at different points in the vicinity of Hudson, the results of which are shown upon the accompanying chart.*

It suffices to say in regard to these results that rock was developed at a depth of from 7 feet to 17 feet below mean low water from the State dam at Troy to Breakers Island, a distance of 3½ miles. Thence for a distance of 8 miles to the Overslaugh Rock no rock was found above the depth of 22 feet. From the Overslaugh Rock to Staats, a distance of 1½ miles, rock outcrops in a few places above the plane of 22 feet, mean low water. From Staats to Mulls, a distance of 5 miles, no rock occurs except in small quantity at Cedar Hill Bar, lying west of the channel. Between Mulls Cross-Over and Hudson no rock was found except at Matthews Point, just below New Baltimore, where a narrow reef running from bank to bank and rising to 13.6 feet below low water was developed.

ADDITIONAL REGULATION OF THE RIVER.

It has already been stated that existing artificial works for regulating the river terminate at New Baltimore. These works, in part, have been in operation now for nearly twenty-five years, and while the depths in the channel embraced between the revetted banks have gradually and continuously increased to the advantage of the navigation of the river, there are evidences that at at least one bar below New Baltimore, viz, Stonehouse Bar, some deterioration by shoaling is going on, which must be provided for by the downward extension of the artificial works, even if no enlargement of present projects for improvement is authorized.

The Board has studied the reach of the river from New Baltimore to Coxsackie with some degree of care, and has estimated approximately for a system of new works on both banks designed to regulate this reach as well as to protect the banks of the river and of intervening islands against degradation by currents and wave action. The precise character of the proposed works, their extent, and their true location, are left to the determination of the local officer when the new project for improvement is adopted, and when funds for construction become available by future appropriations.

The Board will state generally that the main channel should be carried over Stonehouse Bar, and the secondary channel behind Bronks Island should be closed, by building a dike from a convenient point in South New Baltimore along the eastern margin of the shoal at the head of Bronks Island, and continued along that island as far as may be decided necessary; that the unprotected and exposed heads and shores of Bronks, Light House, and Coxsackie islands should be revetted so as to protect them against abrasion, leaving the channels behind the two latter islands open for commercial uses, and that the eastern shore of the river from Stuyvesant Light to Nutten Hook should be revetted in a suitable way for the better maintenance of the channel. The Board also thinks that the shoal forming at the lower end of Coxsackie Island should be removed and that the river should be given a cross section at that point not less in area than that at Coxsackie Landing, immediately below.

---

*Not reprinted; printed in House Ex. Doc. No. 23, Fifty-second Congress, first session.

The aggregate length of shore line for which protection is recommended is about 40,000 linear feet, and the estimated cost of the proposed works is $350,000, approximately.

The estimated cost of these constructions, which are included in the estimates required of the Board, are necessarily only approximate, as the absolute cost can only be determined after more detailed studies have been given to the subject by the local officer.

The Board further thinks that increased depths where needed below Coxsackie can be more quickly and economically obtained by the usual method of dredging than by a resort to permanent works of improvement.

ESTIMATES OF COST.

The act of September 19, 1890, under which this report is submitted, calls for three distinct projects of improvement, two of which provide for a channel navigable for vessels drawing 20 feet, and one for a depth of 12 feet at mean low stage of the river. The Board now presents separate estimates for these projects:

1. ESTIMATE OF COST OF WIDENING AND DEEPENING THE HUDSON RIVER BETWEEN NEW YORK AND ALBANY, FOR THE NAVIGATION OF SEAGOING VESSELS DRAWING 20 FEET OF WATER, AFFORDING A CHANNEL 400 FEET WIDE AND 22 FEET DEEP, MEAN LOW WATER, WITH SIDE SLOPES OF ONE ON ONE IN ROCK, ONE ON THREE IN SAND.

a. From Hudson City to New Baltimore (Hudson Channel).

1. Priming Hook Shoal, dredging	cubic yards	399,925	
2. Four Mile Point Shoal, dredging	do	1,583,452	
3. Coxsackie Shoal, dredging	do	855,861	
4. Bronks Island Shoal, dredging	do	535,287	
5. Stone House Bar, dredging	do	983,903	
Total dredging	do	4,358,428	
Amounting, at 20 cents per cubic yard, to			$871,685.60
6. Reef at Matthews Point, removing 17,482 cubic yards rock, at $10 per cubic yard			174,820.00
			1,046,505.60

b. From New Baltimore to Albany.

1. Willow Island Shoal, dredging	cubic yards	1,636,616	
2. Coeymans Shoal, dredging	do	1,006,231	
3. Mulls Cross-Over, dredging	do	2,969,119	
4. Cedar Hill Bar, dredging	do	1,610,615	
5. Winnies Bar, dredging	do	956,207	
6. Van Wies Shoal, dredging	do	1,554,592	
7. Bogart Light Shoal, dredging	do	1,794,398	
8. Cuylers Bar, dredging	do	1,859,874	
Total dredging	do	13,387,652	
Amounting, at 20 cents per cubic yard, to			2,677,530.40
9. Mulls Cross-Over, rock removal	cubic yards	46,570	
10. Cedar Hill Bar, rock removal	do	9,216	
11. Overslaugh, rock removal	do	76,342	
Total rock removal	do	132,128	
Amounting, at $10 per cubic yard, to			1,321,280.00
Additional regulation work			350,000.00
			5,395,316.00
Contingencies, 10 per cent			539,531.60
Total			5,934,847.60

2. ESTIMATE OF COST OF WIDENING AND DEEPENING THE HUDSON RIVER BETWEEN NEW YORK CITY AND THE STATE DAM AT TROY, FOR THE NAVIGATION OF SEA-GOING VESSELS DRAWING 20 FEET OF WATER, AFFORDING A CHANNEL 400 FEET WIDE AND 22 FEET DEEP, MEAN LOW WATER, TO THE FOOT OF BROADWAY, TROY, AND THENCE TO THE DAM AT TROY, 200 FEET WIDE AND 22 FEET DEEP, MEAN LOW WATER, INCLUDING THE FORMATION OF A BASIN BELOW THE DAM.

a. From Hudson City to Albany.

	Same as in first estimate, above			$5,395,316.00

b. From Albany to State Dam at Troy.

1.	Kellogg Shoal, dredging	cubic yards	1,909,285	
2.	Fish House Shoal, dredging	do	1,421,498	
3.	Round Shoal and Covills Folly, dredging	do	1,866,965	
4.	Van Burens Bar, dredging	do	971,808	
5.	Washington Bar, dredging	do	745,208	
6.	Washington Bar to foot of Broadway, dredging	do	494,158	
7.	From foot of Broadway to State Dam, dredging	do	531,465	
	Total dredging	do	7,940,387	
	Amounting, at 20 cents per cubic yard, to			1,588,077.40
8.	Breakers Island, rock removal	cubic yards	140,924	
9.	Arsenal, rock removal	do	510,092	
10.	Troy to State Dam, rock removal	do	424,084	
	Total rock removal	do	1,075,100	
	Amounting, at $10 per cubic yard, to			10,751,000.00
				17,734,393.40
	Contingencies, 10 per cent			1,773,439.34
	Total			19,507,832.74

3. ESTIMATE OF COST OF IMPROVING THE HUDSON RIVER BETWEEN COXSACKIE AND THE STATE DAM AT TROY TO SUCH AN EXTENT AS TO SECURE A NAVIGABLE CHANNEL 12 FEET DEEP AT MEAN LOW WATER, THE CHANNEL TO BE 400 FEET WIDE FROM COXSACKIE TO FOOT OF BROADWAY, TROY, AND 300 FEET WIDE FROM FOOT OF BROADWAY TO STATE DAM AT TROY, THE SIDE SLOPES IN ROCK TO BE ONE ON ONE, AND IN SAND ONE ON THREE.

a. From Coxsackie to Albany.

1.	Coxsackie Shoal, dredging	cubic yards	106,072	
2.	Stone House Bar, dredging	do	58,323	
3.	Willow Island Bar, dredging	do	275,089	
4.	Coeymans Shoal, dredging	do	60,842	
5.	Mulls Cross-Over, dredging	do	367,104	
6.	Cedar Hill Bar, dredging	do	112,800	
7.	Winnies Bar, dredging	do	85,938	
8.	Van Wies Shoal, dredging	do	223,362	
9.	Bogart Light Shoal, dredging	do	342,048	
10.	Cuylers Bar, dredging	do	271,669	
	Total dredging	do	1,903,247	
	Amounting, at 20 cents per cubic yard, to			$380,649.40
11.	Overslaugh, removing 1,495 cubic yards rock, at $10 per cubic yard			14,950.00
				395,599.40

b. From Albany to State Dam.

1.	Kellogg Shoal, dredging	cubic yards	387,688	
2.	Fish House Shoal, dredging	do	484,126	
3.	Round Shoal and Covills Folly, dredging	do	602,278	
4.	Van Burens Bar, dredging	do	288,829	
5.	Washington Bar, dredging	do	356,350	
6.	Washington Bar to foot of Broadway, dredging	do	87,988	
7.	Foot of Broadway to State Dam, dredging	do	509,542	
	Total dredging	do	2,716,801	
	Amounting, at 20 cents per cubic yard, to			543,360.20

8. Breakers Island, rock removal ... cubic yards..	8,942	
9. Arsenal, rock removal ... do....	2,824	
10. Foot of Broadway to State Dam, rock removal ... do....	81,875	
Total rock removal ... do....	93,641	
Amounting, at $10 per cubic yard, to		$936,410.00
Additional regulation work		350,000.00
		2,225,369.60
Contingencies, 10 per cent		222,536.96
Total		2,447,906.56

RECAPITULATION.

No. 1. For channel 22 feet deep and 400 feet wide from New York City to Albany.

From Hudson City to Albany:	
Dredging 17,746,080 cubic yards, at 20 cents	$3,549,216.00
Removing 149,610 cubic yards rock, at $10	1,496,100.00
Additional regulation work	350,000.00
	5,395,316.00
Contingencies, 10 per cent	539,531.60
Total	5,934,847.60

No. 2. For channel 22 feet deep and 400 feet wide from New York City to foot of Broadway, Troy, and thence 22 feet deep and 200 feet wide to State Dam at Troy.

From Hudson to State Dam at Troy:	
Dredging 25,686,467 cubic yards, at 20 cents	$5,137,293.40
Removing 1,224,710 cubic yards rock, at $10	12,247,100.00
Additional regulation work	350,000.00
	17,734,393.40
Contingencies, 10 per cent	1,773,439.34
Total	19,507,832.74

No. 3. For channel 12 feet deep and 400 feet wide from Coxsackie to foot of Broadway, Troy, and thence 12 feet deep and 300 feet wide to State Dam at Troy.

From Coxsackie to State Dam:	
Dredging 4,620,048 cubic yards, at 20 cents	$924,009.60
Removing 95,136 cubic yards rock, at $10	951,360.00
Additional regulation work	350,000.00
	2,225,369.60
Contingencies, 10 per cent	222,536.96
Total	2,447,906.56

Having presented the projects and estimates of cost for widening and deepening the river, as required by the act under the provisions of which this report is submitted, the Board now passes to the consideration of the second part of its instructions, which requires a statement as to the usefulness of such improvements and of their relations and value to commerce, and of the advisability of entering upon the same at this time. This subdivision of the subject relates directly to the character and extent of the present commerce of the river and the means by which it is transported, to possible modifications of that commerce in the future, and to the expediency of now enlarging the widths and depths of the existing channels to facilitate and maintain the present commerce and to encourage and provide for its future development.

The Hudson River is an arm of the sea extending inland for 150 miles. For 100 miles from its mouth the channel is adequately wide and deep for the largest vessels, but beyond to the head of navigation it is narrow, crooked, and obstructed by shoals and rocks.

The present relations of the river to commerce are of a twofold character. First, it carries a very large local traffic, larger indeed than that of any other river in the United States; and secondly, it forms an important part of a great system of waterways extending through the northern lakes to the sea. It is impossible to divide the commerce of the river into classes corresponding with any degree of accuracy to these two relations; but it will be sufficient for the purposes of this report to consider as *local* traffic the movement of all materials which do not come to the river through the State canals, and as *through* traffic the movement of all materials which come through the canals and are principally carried down the river to the sea, where they are in part shipped to foreign ports.

Considering simply the tonnage transported, the local traffic of the river is by far the more important, and accordingly attention is first invited to this branch of the subject.

The latest reliable information concerning the commerce of the Hudson River is contained in the Annual Report of the Chief of Engineers for 1890, the statistics of which were collected and tabulated with great care and thoroughness. It appears from this report that some of the principal sources of the local commerce of the Hudson are as follows:

The Delaware and Hudson Canal, which enters the river at Rondout, N. Y., connects the Hudson with the anthracite coal region at Honesville and the Delaware River. The principal items of tonnage on this canal are coal, bluestone, and cement. The Pennsylvania Coal Company has a large tide-water coal depot at Newburg, where also the Erie Railroad transfers large quantities of freight by boat across the river. The Erie Railroad has a coal depot at Piermont, 20 miles above New York, where a large supply is to be handled.

The two principal industries of the river which materially increase the total tonnage are ice and brick. The amount of ice annually harvested generally exceeds 3,500,000 tons and the number of bricks manufactured 850,000,000.

The total tonnage of all shipping points on the river during 1890, exclusive of the tonnage transported through the State canals—that is, the tonnage corresponding to the local traffic—was 15,033,309 tons. It was nearly three times the tonnage of the through traffic.

In addition to this enormous commerce, the passenger traffic should be mentioned. In 1890 there were thirty transportation companies for passengers or freight, not including individual steamboats or pleasure boats. The total number of passengers carried was about 5,000,000.

But although the volume of the local traffic so greatly exceeds that of the through traffic, the commercial relations of the river considered as a part of the great system of northern and western water transportation are, from a national point of view, by far the more interesting and important.

The commerce derived from remote sources through connecting artificial water ways, or which may be so derived by future works, is a branch of the subject which was strongly emphasized by the unexpected direction which the discussions took at the public hearings, and the Board desires to give it as liberal consideration as its instructions permit.

The Northwest is now, and will continue to be in the future, the great food-producing region for the States along the coast and for a part of Europe. The map shows at a glance the vast extent of the territory tributary to the Great Lakes, the products of which can be delivered at the lake ports and thence shipped to Lake Erie or Lake Ontario, whence they can be carried by various land and water routes to the sea. From the head of Lake Superior at Duluth, the line of water transportation extends through Lake Superior and the St. Marys Falls Canal into Lake Huron, where it joins the lines from Chicago and Milwaukee through Lake Michigan; it passes through Lake Huron, the St. Clair Flats Canal, and the Detroit River into Lake Erie and through the Welland Canal into Lake Ontario. The capacity of this route for navigation is determined by the minimum depths along it, which are at the lake ports, the St. Marys Falls Canal, the St. Clair Flats Canal and Detroit River, and the Welland Canal. The lake ports, St. Marys Falls Canal, St. Clair Flats Canal, and Detroit River carry at present a minimum depth of 16 feet; but the projects for improvement now in progress contemplate in all these localities a depth of 20 feet, which will doubtless be secured in the near future. The Welland Canal, which is in foreign territory, carries a depth of 14 feet.

In addition to the enormous volume of transportation along this route large quantities of grain, lumber, and ore are shipped from territory in the vicinity of Lakes Ontario and Champlain.

The importance of the Hudson River in its relations to these great routes of water transportation lies in the fact that it forms a part of all but one of the lines connecting Lakes Erie, Ontario, and Champlain with the sea; and the location and character of these connecting lines, as well as the relative volumes of the commerce passing over them, must be briefly considered in order to obtain a definite idea of the value of the river to commerce.

The routes referred to are as follows:

1. *The Erie Canal route.*—The Erie Canal connects Lake Erie at Buffalo with the Hudson River at Troy and Albany, a distance of about 352 miles. It has 71 lift and 2 guard locks. It has a depth of 7 feet over miter sills. The capacity of the locks is now being enlarged, but the depth is not being increased. The total distance from Lake Erie to the sea by this route is about 482 miles, and to Liverpool about 3,922 miles.

2. *The St. Lawrence route.*—This route connects Lake Erie with tide water at Montreal, on the St. Lawrence, as follows: From Lake Erie to Lake Ontario by the Welland Canal, thence through Lake Ontario to the head of the St. Lawrence River, and thence by the river and the five canals around its shallows to Montreal. This route has 53 locks, and the distance from Lake Erie to Montreal is about 375 miles. The distance from Lake Erie to Liverpool is about 3,220 miles. The minimum depth is now 9 feet in the St. Lawrence canals, but an increase to 14 feet depth is in progress.

3. *The Oswego Canal route.*—This route connects Lake Ontario at Oswego with the Hudson River at Troy and Albany as follows: By the Oswego Canal from Oswego to the Oneida River; thence by the canal to Syracuse and also by the Oneida River, lake, and canal to Durhamville, and from Syracuse or Durhamville by the Erie Canal to Troy and Albany. The length of the route is about 208 miles. It has 67 locks and a depth of about 7 feet.

4. *The Champlain Canal route.*—This route connects Montreal with the Hudson River as follows: From the St. Lawrence River, 45 miles below Montreal, to Lake Champlain by the Chambly Canal; thence through the Champlain Canal to Waterford, 3 miles above the State

dam, and thence by lock to tide water on the Hudson at Troy, or by Erie Canal to Albany. This route has 30 locks. The minimum depth is 7 feet, and the distance from Montreal to Albany 311 miles.

The Board has not attempted a complete analysis of the commerce transported over these routes to the sea, the information available not being sufficient for this purpose, but the following statistics, compiled from the reports of the Census Bureau, the Canadian Department of Railways and Canals, and the Chief of Engineers, U. S. Army, and from other authentic sources, will give a general idea of the volumes of traffic over the different lines:

During the year ending June 30, 1890, the total quantity of freight passing through the Detroit River was nearly 20,000,000 tons. The amount passing through the New York State canals was 5,246,102 tons, of which the Oswego Canal carried 225,936 tons, the Champlain Canal 1,520,757 tons, and the Erie Canal 3,499,409 tons. The amount passing through the Welland Canal during the season of navigation in 1890 was 978,692 tons, of which 263,697 tons were transported by water to and from Montreal, and 533,957 tons were moved between the ports of the United States. The total quantity of freight coming to and leaving the Hudson River through the State canals was 3,592,437 tons.

A great portion of the material thus transported finds a market in our own country and would not, under any circumstances, be carried in seagoing ships. A study of the statistics of the eastward movement of grain along the different routes may perhaps serve to indicate more clearly their relative importance in connection with the export commerce of the country.

During the season of 1890 the quantity of grain carried to tide water by the New York State canals was 1,131,298 tons, and by the New York State railways, 3,045,302 tons. The quantity carried to Montreal through the St. Lawrence canals was 242,571 tons, and by rail, 119,208 tons. The total quantity transported over these routes was 4,583,390 tons. It thus appears that about seven-tenths of the whole quantity moved was carried over the railways and about three-tenths over the water ways. Less than one-tenth was moved over Canadian routes.

The figures given in the above statements will serve to indicate in a general way the great extent and value of the commerce of the Hudson River. There is no river in the United States, except the Detroit and St. Clair rivers, comparable with the Hudson River for the extent, variety, and value of its commerce, the number of its transportation companies, the number and variety of its steam and sailing vessels and barges, and the number of passengers transported; and the relations of the river to the lake navigation are peculiarly interesting and significant. In this connection attention is invited to the able papers in the appendix read before the Board by Hon. James H. Manning, mayor of Albany; Mr. S. A. Thompson, secretary of the Duluth Chamber of Commerce; Hon. Vreeland H. Youngman, Albany Chamber of Commerce; Hon. H. C. Burleigh, of Whitehall; Hon. Martin I. Townsend, of Troy, and others, to all of which the Board has given the most careful consideration.

In discussing the question of the expediency of now enlarging the widths and depths of the existing channels, it appears desirable for the sake of clearness to examine the subject in two parts; first, in relation to existing commercial conditions, and secondly, with reference to the probable future development of commerce. Under these heads, therefore, the Board proposes to investigate, first, the usefulness of improving the channel to a depth of 12 feet at mean low water, and secondly, the expediency of its enlargement to greater depths.

This arrangement, although it does not conform to the order indicated in the act, seems the more satisfactory; for, as will appear in the sequel, the enlargement of the channel to a depth of 12 feet need not necessarily be considered as the full completion of the improvement, but may be regarded as merely the commencement of a more extended project to be executed when found desirable in the future.

The Board now proceeds to consider the usefulness of improving the channel of the river to a depth of 12 feet at mean low water, between Coxsackie and the State Dam at Troy, under the conditions of commerce existing at the present time. Such an improvement would evidently be of no benefit to the through traffic, for none of the water lines connecting the Hudson with the lakes have a greater depth than 7 feet. The present river depths are ample for vessels passing over these connecting lines, and the increase of river depth proposed would not be sufficient for the navigation of ocean-going freight vessels.

As regards the local traffic, however, the conditions are entirely different. The study of the commercial history of the river for a number of years past impresses the Board with the conviction that the existing project for improvement, adopted in 1867, which provides for a navigable depth of 11 feet, mean low water, only to Albany, and of 9 feet to Troy, does not give adequate facilities for the large commerce transported upon the river. These depths barely exceed the draft of the largest vessels which navigate the river to the points named, and when from any cause new bars are formed, or old ones are enlarged or extended, the injuries suffered by commerce at extreme low stages through detentions in various ways at the shoal obstructions are serious and oppressive. In view of the necessities of the commerce incident to the river proper and its tributary country, the Board is of the opinion that the project for improvement adopted in 1867 should be extended so as to provide for a channel depth of at least 12 feet at mean low water, and that such an extension is well worth the expenditure required for its execution.

The proposed projects for the improvement of the river channel up to Albany, and also up to the State Dam at Troy, for the navigation of seagoing vessels drawing 20 feet of water (that is, to a depth of at least 22 feet), bear relations to existing commercial conditions very different from the 12-foot project above considered. As regards the *local traffic* it is probable that it will not under any circumstances be conducted in vessels of 20 feet draft, and a channel of 22 feet depth would be of but little more practical benefit to that traffic than the 12-foot channel above referred to. It is therefore with reference to the *through traffic* alone that the Board thinks this project for a channel of 22 feet depth worthy of careful investigation. The arguments in favor of such an improvement were fully and ably presented to the Board at its two public meetings held at Albany and at New York. These arguments, so far as they relate to existing commercial conditions, may be briefly summarized as follows:

By the construction of a deep-water channel to Albany and Troy the ocean will be directly joined to the canals. Vessels navigating the canals can then discharge their cargoes at Albany and Troy, avoiding the expense and delay of going down the river to New York, and thus the carrying capacity of the canals will be increased. The difference in cost of transportation to New York would be saved. It is argued that, owing to the expense and delay arising from the lack of terminal facilities at New York, seagoing vessels would prefer to take their cargoes at Troy and Albany were the channels of sufficient dimensions for their navigation. A large quantity of lumber, now generally shipped in bond by rail from Ottawa, Canada, to Boston for export, could, if the channels were deepened, be sent by rail to Albany and thence shipped direct to South American and other foreign ports with a considerable reduction in expense. Finally, attention was invited to the importance of a deep-water channel in case of war, so that our vessels could go directly to the Watervliet Arsenal for military supplies.

The Board has given these arguments careful consideration, and begs to submit the following remarks in relation thereto: While it is doubtless true that the traffic of the Hudson River would be materially increased if seagoing vessels could and would go to Albany or Troy to take their cargoes, it is believed that such increase would be principally if not wholly derived from materials brought to the shipping points by rail, such as the lumber from Canada referred to above. The carrying capacities of the canals are determined principally by the number of boats which can be passed daily through their locks, and these capacities can be increased only by improvements in their lockage facilities. Such improvements are now in progress on the Erie and Oswego canals, but they do not provide for any increase of depths. The Board is of the opinion that the volume of through traffic on the canals can not be sensibly increased by the construction of a deep-water river channel so long as the navigable depths of the canals remain unimproved.

But the Board considers it doubtful if any considerable number of seagoing vessels would go to Albany or Troy to receive cargoes even if a deep-water channel existed. If, as has been stated, the terminal facilities at New York are inadequate and unsatisfactory, they can and doubtless will be improved at points nearer than Albany and Troy, for there is no lack of natural advantages in the harbor and its immediate vicinity.

New York is the center of a vast population, and the point from which by far the greater proportion of incoming commerce is and must always be distributed. Seagoing vessels receiving their cargoes at Troy or Albany would, therefore, generally have to go to these points in ballast. Considering the delay, cost of pilotage, and other incidental expenses, the Board doubts whether any material saving in the cost of transportation would result. Wheat has been carried this summer from Chicago to New York for 5 cents per bushel, and the Board is not convinced that, under existing conditions, a sufficient reduction in cost of transportation would result from the deepening of the Hudson to produce an effect upon the relative quantities transported over the different routes which would justify the large expenditure involved. If the extension of the deep-water channel is desirable, why, it may be asked, is not the Hudson now navigated by seagoing vessels to the existing head of the deep-water channel at Athens or Hudson, 100 miles from New York? This question has been answered by the statement that at these points there are no facilities for distribution and no adequate connections with the great lines of through transportation. But it seems probable that such facilities and connections would soon be provided if they were urgently demanded by the necessities of commerce.

In this connection attention is invited to a communication from the committee on harbor and shipping of the New York Chamber of Commerce, submitted to the Board at its request, wherein the portion of commerce which may possibly be affected by the proposed improvement is presented. This paper will be found in the appendix.

The committee concludes that the improvement can not be of benefit to sailing vessels or steamers of the regular lines, and that advantage can be derived therefrom only by transient freight-seeking steamers with a loaded draft of 20 feet or less, during the brief period between harvest and the closing of the canals, and in spring from the opening of the canals until the movement of the crops ceases. The figures submitted by the committee indicate that the total exports from New York in 1890 were 6,258,222 tons, of which 4,829,775 tons were shipped by steamer. The tonnage brought to tide water from the canal system, much of which was distributed in the United States, was 3,024,765 tons. The exports derived from the canals, carried by the regular steamer lines, are estimated by the committee at 1,503,161 tons, and by the transient steamers 278,831 tons. The amount carried by transient steamers of a draft of 20 feet or less, which the committee considers could alone be benefited by the proposed improvement, is estimated at 75,390 tons.

If these statements be accepted it is reasonable to suppose, however, that in case improvements in depth are effected, a larger number of steamers conforming to the modified conditions would be provided, if these were made sufficient to invite them.

The Board does not feel called upon to express an opinion as regards the necessity of this improvement for military purposes, this branch of the subject not having been included in its instructions. The authorities in charge of matters relating to the national defense will doubtless determine whether it is desirable to locate our military establishments where adequate water communications now exist or improve the lines of water transportation to other points.

In view of the facts and reasons above set forth, the Board is of the opinion that the possible benefits to commerce to be derived from the proposed improvement for vessels drawing 20 feet are not under existing conditions sufficient to justify at this time the expenditure necessary to make such improvement.

But a very important branch of the subject still remains to be considered, viz, the relations of these improvements to the future development of commerce. It can not be doubted that this development will continue as rapidly as in the past, for the grain-producing area is continually extending towards the Northwest. The Board is fully impressed with the importance of these lines of water transportation in their relations to the large and rapidly increasing traffic from the lakes to the sea. The relative volumes carried by water and by rail have already been indicated; but even if improvements in the water routes should not increase the relative quantities transported over them, the Board is of the opinion that such improvements will be of the greatest benefit to commerce. The influence of these routes in the reduction and control of railway rates has a commercial value far greater than is indicated by the mere tonnage carried. It is also evident that as population increases and the development of the railway system approaches its profitable limit the relative importance of the lines of water transportation will be augmented, and the necessity for improving them to their utmost capacities will finally become imperative. A large portion of these lines is not under the control of the General Government, but the Board is of the opinion that the part which is under such control should always be fully developed to keep pace with the improvements made along the interior and connecting lines.

The attention of the Board has been invited to the fact that the Canadian Government is now engaged in the improvement of its water route from the lakes to the sea, and soon will have established a route from Lake Erie through Lake Ontario and down the St. Lawrence River with a minimum depth of 14 feet. When this route is completed it is feared by the advocates of the improvement now under consideration that a considerable part of the commerce now traversing our own water ways will be diverted through a foreign country, unless the change is met by corresponding improvements in our own water routes. In this connection, however, it should be remarked that only about 8 per cent of the products of the Northwest finds its way to the sea for export. The grain product of the United States and Canada for 1890 is estimated at about 2,650,000,000 bushels, while the quantity of grain exported, including flour, during the same year was about 211,000,000 bushels, or less than one-twelfth (8 per cent of the total production). The market for by far the greater part of these products lies in our own country, south of the lakes and the St. Lawrence, and no improvement of water ways in Canada or elsewhere can greatly influence the general direction of its movement.

But although this danger of losing a part of our carrying trade has, perhaps, been somewhat magnified, it is still a real one; and accordingly various projects for the improvement of our water routes have been proposed and discussed. The most important of these—indeed, the only one which need be considered in connection with the proposed improvement of the Hudson—is the radical enlargement of the Erie Canal, so as to permit its navigation by the largest vessels now carrying the commerce of the Great Lakes. This project requires an increase of depth to at least 18 feet, a corresponding widening, and reconstruction of the entire lock system on a grand scale. The cost of the work involved has been variously estimated at from one hundred and fifty to two hundred and fifty millions of dollars. The Board begs to refer to a paper by Mr. E. Sweet, and the accompanying discussion by other distinguished engineers, published in the transactions of the American Society of Civil Engineers, February, 1885, in which this project is fully and most ably considered.

Should this proposed enlargement of the Erie Canal be effected, the Board is of the opinion that the full deepening of the Hudson River to 22 feet would become a necessity, but for reasons very different from those considered in connection with the conditions of commerce as they now exist. The object of the improvement would no longer be to bring seagoing vessels to Albany and Troy to receive their cargoes, but to enable vessels navigating the lakes to carry their cargoes clear through, not only to the coast but also to foreign ports, without rehandling them at any intermediate points.

In view of the vast commercial interests involved, such an improvement in the future can not be considered as beyond the limits of possibility; but the Board believes its commencement, or even its serious contemplation at the present time, to be highly improbable. The responsibility of the large expenditure required will not be assumed until it is settled beyond a doubt that commensurate benefits will be obtained; and this is a question with reference to which the views of experts are still at variance. The plans now in process of execution by the State of New York to increase the capacity of the canals do not contemplate the ultimate formation of channels for ships, but involve large expenditures which will be completely useless should a deep-water project be finally adopted.

The improvement of the several water routes from the lakes to New York City, on a much less extensive scale than that proposed at the public hearing, received the consideration of Congress in 1874, and for information of the details of the improvement then proposed and the estimated cost, the Board invites attention to the report on the "Third Subdivision of the Northern Transportation Route," through northern and central New York, made to comply with the act of Congress approved June 24, 1874, and contained in the Annual Report of the Chief of Engineers for 1875, Part II, page 534.

Finally the Board invites attention to the interesting experiment now under trial of carrying unbroken cargoes through from Duluth to Liverpool in vessels of only 14 feet draft. On June 11, 1891, the *Charles W. Wetmore*, a steel vessel of the new "whaleback" type, left Duluth for Liverpool with a cargo of 70,418 bushels of wheat, this being the first clearance from Lake Superior for a foreign port. She passed through the lakes and Welland Canal, lightering a part of her cargo at Kingston and taking it on again with an additional load at Montreal, proceeded down the St. Lawrence to the sea, and finally arrived at Liverpool with 87,503 bushels of wheat on July 21, 1891. When the improvements now in progress on the Canadian canals are completed, it is said that such a vessel will be able to carry an unbroken cargo of nearly 3,000 tons from Lake Superior to a foreign port and return. The successful introduction of such vessels may possibly revolutionize the carrying trade of the Great Lakes, and render unnecessary the formation of channel depths so great as are now considered desirable in the lines of water transportation.

In view of the above considerations the Board is of the opinion that the present demands of commerce, and its probable development in the near future, do not now justify the expenditure of the amount of money necessary for the formation of the proposed channel for seagoing vessels drawing 20 feet of water from New York to Albany or to the State Dam at Troy.

CONCLUSIONS OF THE BOARD.

The Board, after thoroughly analyzing the duties imposed upon it by the act of September 19, 1890, now presents its conclusions with some degree of confidence that every legitimate interest submitted to its judgment has had its full share of consideration.

First.—The estimates of cost of carrying out the two projects contained in the said act, which provide for widening and deepening the channels between New York City and the city of Albany, and between New York City and the city of Troy, for the navigation of seagoing vessels drawing 20 feet of water, are $5,934,847.60 and $19,507,832.74, respectively.

The improvements to be effected by this large expenditure will, in the opinion of the Board, confer no important practical benefit upon commerce until the suggested artificial water connection, 350 miles long and of adequate depth, is made between the Hudson River and Lake Erie, through the State of New York, at an additional cost estimated as high as $150,000,000 to $250,000,000.

In view of the excessive cost of these several projects, singly or combined; of the improbability that either the State or the General Government will assume, at an early day, the responsibility of making such an artificial deep-water connection; and of the long period of time which must necessarily elapse before such a connection can be made between river and lake, even if such an undertaking were in progress to-day, the Board is of the opinion that it is not advisable at this time to enter upon the projects for deepening the Hudson River from the mouth to Albany, or to Troy, N. Y., for the navigation of sea-going vessels drawing 20 feet of water. What is practically the commencement of such a project with a view to its ultimate complete execution in the future, when the needs of commerce require it, is, however, considered desirable; but the Board is of the opinion that the improvement should not be carried to the full depth of 22 feet at the present time.

Second.—After carefully studying the wants of commerce, the Board is of the opinion that the third project contained in the act of September 19, 1890, which provides for improving the Hudson River "between Coxsackie and the State Dam at Troy to such an extent as to secure a navigable channel 12 feet deep at mean low water," is a worthy and useful one, and accordingly recommends it for adoption.

In the estimates submitted for this project, the Board has adopted a channel 400 feet wide to Troy, and thence 300 feet wide to State Dam at Troy.

The Board recommends that the regulating works between Troy and New Baltimore, provided for in the existing project, be maintained and that supplementary regulating works of a permanent character be provided between New Baltimore and Coxsackie.

The Board describes in a general way only the supplementary works required to be built, as it is expected that further study and investigation as the work of improvement progresses may lead the local officer to recommend a modification of such works both as regards their location and extent, as well as the exact dimensions which shall be given to them.

In conclusion, in order that the good results which may be expected to follow upon the completion of the recommended project may be realized at the earliest practicable moment, the Board further recommends that liberal appropriations, commensurate with the importance of the work, be made annually, so that the desired improvement may be completed within a period not exceeding five years.

The papers enumerated below accompany this report as appendixes:*

(1) Report of Mr. Charles G. Weir, assistant engineer, dated July 21, 1891, on borings made along the bed of the Hudson by direction of the Board of Engineers.
(2) Stenographer's report of the public meeting held in Albany January 6, 1891.
(3) Stenographer's report of the public meeting held in New York May 15, 1891.
(4) Communication from the committee on harbor and shipping of the New York Chamber of Commerce.
(5) Letters and resolutions filed with the Board of Engineers by the secretary of the Chamber of Commerce, Albany, N. Y.

G. L. GILLESPIE,
Lieut. Col. of Engineers.
AMOS STICKNEY,
Major of Engineers.
C. W. RAYMOND,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

---

* Not reprinted; printed in House Ex. Doc. No. 23, Fifty-second Congress, first session.

E 2.

IMPROVEMENT OF SAUGERTIES HARBOR, NEW YORK.

The harbor of Saugerties is at the mouth of Esopus Creek, which empties into the Hudson River on the west shore, about 100 miles above the city of New York. With the exception of some slight works undertaken by the inhabitants, giving no permanent results, nothing had been done towards the improvement of this harbor until it was undertaken by the United States Government in 1887. In 1883 a survey of the harbor was made, under the direction of the engineer officer in charge, which indicated that there was a shoal at the entrance 1,100 feet wide between 6-foot contours, over which the least depth was 3 feet, mean low water. Two plans of improvement were recommended, both providing for the construction of parallel dikes and for dredging the channel between them 7 feet deep, mean low water. (See Annual Report of the Chief of Engineers for 1884, Part I, page 716.)

The reëxamination of the harbor, made in 1887, after the State had done some dredging in the channel, resulted in the submission of a third project, differing from those previously submitted only in the direction to be given to the dikes. The range of tides is 4 feet approximately.

The project of 1887 was approved, and its execution was begun the same year.

Its estimated cost was as follows (see Annual Report of the Chief of Engineers for 1887, Part I, page 662):

North Dike, 2,300 feet long:	
Pile work, 2,160 running feet, at $7 per foot	$15,120
Crib work, 140 running feet, at $30 per foot	4,200
South Dike, 2,300 feet long:	
Pile work, 2,200 running feet, at $7 per foot	15,400
Crib work, 100 running feet, at $30 per foot	3,000
Dredging, 30,000 cubic yards, at 25 cents	7,500
Contingencies, about 15 per cent	6,780
Total	52,000

At the close of the fiscal year ending June 30, 1891, under appropriations made in 1884, 1886, and 1888, aggregating $32,000, the South Dike had been completed its projected length of 2,363½ feet, and the North Dike for a length of 809½ feet. The waterway between them had also been dredged so as to afford a channel 100 feet wide and 9 feet deep, mean low water, from the inner harbor eastward to the Hudson River. The inner harbor had, at that time, for a distance of 2,000 feet, a channel 150 feet wide and 14½ to 20 feet deep, mean low water.

The width of the waterway between the North and South Dikes at that date was 260 feet; the channel across the bar was 200 feet wide and 9 feet deep, mean low water, and work on the North Dike extension was in progress.

In past years the channel at the entrance has shoaled up by reason of ice gorges which formed at the mouth before the ice broke up in the Hudson. The shoals formed in this way were partially removed by subsequent spring freshets.

The purpose of the dikes is to contract the channel, to promote the scour of the freshets, and to maintain the improved navigable depths during the low stage of summer, which usually lasts for two months approximately.

As the direct result of the improvements which have been made by the Government vessels with draft of 12 feet and upward are now enabled to reach the factories at high tide. The river and harbor act of September 19, 1890, appropriated $10,000 for continuing the improvement.

The amount required to complete the improvement in accordance with the approved project is $10,000.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

The river and harbor act September 19, 1890, appropriated $10,000 for continuing this improvement, and at the beginning of the fiscal year July 1, 1891, the work extending the North Dike towards the light-house was in progress, under contract with William Parrott dated December 17, 1890.

This was continued until its completion, August 25, 1891, The dike was extended to the light-house, a length of 1,249.3 feet, at a cost per running foot of $7.22. This dike is 7 feet wide from out to out of piles, and stands 2 feet above mean high water. The following material was furnished and put in by the contractor during the fiscal year:

3,470 linear feet pine piles.
38,625 feet, B. M., square timber.
10,188 pounds tie-rods and screw bolts.
5,395 pounds driftbolts and washers.
1,547 cubic yards stone.

The channel of the creek between the light-house and steamboat wharf is crossed in two places by rock formation. Nearly opposite the upper end of the crib dike built by the United States Government in 1889 are a few high points, on which vessels at very low tide sometimes strike. They should be removed, but as the cost will be slight, no special estimate therefor is submitted. With this exception the channel is in good condition. From the steamboat dock to deep water in the Hudson there is at present a channel width of 150 feet between the 9-foot curves.

The amount expended during the fiscal year ending June 30, 1892, inclusive of outstanding liabilities, was $7,085.30.

An appropriation of $5,000 is recommended to maintain the dikes in proper repair and to remove the rocky points near the shore end of North Dike.

Saugerties is in the collection district of Albany, N. Y., which is the nearest port of entry. The nearest light-house is at the mouth of Esopus Creek.

AMOUNTS APPROPRIATED.

July 5, 1884	$5,000.00
August 5, 1886	15,000.00
August 11, 1888	12,000.00
September 19, 1890	10,000.00
Total	42,000.00
Amount expended to June 30, 1892, inclusive of outstanding liabilities	41,407.06

Money statement.

July 1, 1891, balance unexpended	$7,678.24
June 30, 1892, amount expended during fiscal year	7,085.30
July 1, 1892, balance unexpended	592.94
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,592.94

Amount (estimated) required for completion of existing project	$5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

The commercial carriers are 5 steamboats for freight and passenger traffic, owned by the Saugerties and New York Steamboat Company, the Saugerties and Albany line, and the Saugerties, Rondout and Hudson line, and 405 sailing and other craft, the former carrying 17,000 passengers annually, and in all aggregating 189,000 tons of freight, valued at $5,484,000, the principal products being general merchandise, bluestone, coal, and lumber.

The population of Saugerties is 5,000.

E 3.

IMPROVEMENT OF HARBOR AT RONDOUT, NEW YORK.

The harbor of Rondout is at the mouth of Rondout Creek, which empties into the Hudson River on its west side, about 90 miles above the city of New York.

From the entrance to the lock of the Delaware and Hudson Canal, a distance of 3 miles, the creek is a tidal stream, the range of tides being 4 feet, approximately.

Prior to 1871 improvements had been made by private persons and corporations, but no permanent benefit had been derived from them. In 1869 a survey of the harbor was made by the Government with a view to its permanent improvement, and it was then found that the available depth of water in the channel was about 7 feet.

The project of improvement based upon this survey provided for the formation and maintenance of a channel 100 feet wide and 14 feet deep at the mouth of the creek, to be obtained by means of dredging and diking. Two parallel channel dikes were to be built outward, toward and into the Hudson River, their outer ends curving gently downstream, while a branch dike running upstream along the Hudson from the outer end of the North Dike was to protect that dike from destruction by running ice. The estimated cost of the work was as follows:

Building the North Dike, 748 yards long	$41,600
Building the Branch Dike, 640 yards long	34,400
Building the South Dike, 1,277 yards long	59,600
Dredging a channel 3,000 feet long, 100 feet wide, and 14 feet deep at low water, 48,000 cubic yards at 30 cents	14,400
Contingencies	22,500
Total	172,500

The final length of the North and South dikes was, however, to be determined after observing the effects which they might produce in the removal of the bar as they were gradually extended outward. The work was begun in 1872 and was completed in 1880. It was found by experience that the dikes might be made shorter than originally deemed necessary and the total cost of the work reduced to $90,000, less than two-thirds of the original estimate.

On the completion of the work in 1880 the North Dike was 2,200 feet, approximately, with a branch dike running up the Hudson 1,000 feet, approximately; and the South Dike was 2,800 feet long, approximately, with a spur to the light-house 330 feet long. The distance between the dikes at the entrance was 350 feet, approximately. As the result of the works of improvement there was a channel over the bar, from the creek to the Hudson, 50 feet wide, giving 13½ feet mean low water; 100 feet wide, giving 12 feet mean low water, and 200 feet wide, giving 10 feet mean low water. At the outer end of the dikes the distance between the 12-foot curves was over 300 feet.

The north and branch dikes were originally built to the height of mean high water, while the south dike, for 500 feet west of the light-house, was built only to the level of half-tide. The low part of the south dike was subsequently raised by crib work to mean high water, but even with this increased height the dikes are submerged during storm tides and freshets, and are required to be marked by fender piles to enable vessels to enter the harbor at such times without danger of being wrecked upon the concealed dikes.

The appropriations for this harbor, made since the completion of the works in 1880, have been applied exclusively to the repair of the dikes. The improved depths in the channel have been well maintained, but the dikes have greatly deteriorated, partly owing to the ice, partly to the natural decay of the timber, and partly to the undermining of the piles by scour.

The survey of the harbor made in September, 1889, indicated a continued improvement of the channel between the dikes—not in the enlargement of the width of the 14-foot channel, but in that of the 9-foot channel, which then had a width of 250 feet.

On the south side of the entrance there has been a slight shoaling, due probably to the removal in 1884 of 150 feet from the outer end of the south pier, to meet the wishes of the boatmen, who alleged that their tows required a wider entrance between the piers on that side when coming in with vessels on flood tide. The change in length of the south dike doubtless facilitates entrance at flood tide, but the shoaling of the bar on that side, which is shown by the survey of 1889, makes it probable that the south dike should be increased rather than decreased in length.

The act of August 11, 1888, appropriated $5,000 for continuing the improvement, which was applied towards repairs of both dikes.

The river and harbor act of September 19, 1890, appropriated $5,000 for repairing existing works.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

At the opening of the fiscal year no work of improvement was in progress, as the funds appropriated by the act of August 11, 1888, had been exhausted, and the high stage of water prevailing in the river and harbor till May had not admitted the making of contracts for the expenditure of the appropriation made by the act of September 19, 1890.

Sealed proposals for making the necessary repairs to the north and branch dikes, which were invited by public advertisement according to law May 29, were opened July 2, and the contract was awarded to William Parrott, the only bidder, July 24.

The specifications called for repairs to the north and branch dikes as follows: Where the fender piles were gone and timber works destroyed at the intersection of the north and branch dikes, new fender piles were to be driven and old timbers replaced by new ones; the north dike for 550 feet, where it was undermined and canted over, was to be strengthened by driving a row of piles on front and rear 2½ feet apart from center to center, connected by a single waling timber, screw-bolted to each pile and fastened together front and rear by iron tie-rods; also, stone filling to be placed in these dikes where necessary.

The contractor started work August 15, and completed these repairs in full October 28, 1891. The material furnished and put in the work by the contractor is as follows:

12,000 linear feet pine piles.
604 linear feet white-oak piles.
13,113 feet B. M. square timber.
7,247 pounds tie-rods and screw-bolts.
2,119 pounds driftbolts and washers.
1,400 cubic yards stone.

The channel maintains itself in good navigable condition sufficient for the wants of commerce. While the dikes are in good condition of repair they are much exposed to damage by ice in the river and by boats that frequently run into and break down the timber work at the intersection of the north and branch dikes. Some additional stone filling should be placed in the south dike, and an appropriation of $10,000 is recommended to complete the necessary repairs and make them comparatively permanent.

The amount expended during the fiscal year ending June 30, 1892, inclusive of outstanding liabilities, was $5,000.

Rondout is in the collection district of New York. The nearest works of defense are those in New York Harbor.

AMOUNTS APPROPRIATED.

By act of Congress approved—	
June 12, 1872, diking	$10,000.00
March 3, 1873, diking	20,000.00
Amount allotted June 8, 1875, from repairs of harbors on Atlantic coast, repairs	762.18
From contingencies of rivers and harbors, etc., repairs	237.82
By act of Congress approved—	
August 14, 1876, diking and repairs	30,000.00
June 15, 1878, diking and dredging	30,000.00
By act of Congress passed August 2, 1882, repairs and dredging	2,000.00
By act of Congress approved—	
July 5, 1884, repairs and dredging	1,000.00
August 5, 1886	2,500.00
August 11, 1888, repairs	5,000.00
September 19, 1890, repairs	5,000.00
Total	106,500.00
Amount expended to June 30, 1892	106,500.00

Money statement.

July 1, 1891, balance unexpended	$5,000.00
June 30, 1892, amount expended during fiscal year	5,000.00
Amount appropriated by act approved July 13, 1892	5,000.00
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for repairing dikes at Rondout Harbor, New York, received in response to advertisement dated May 29, 1891, and opened July 2, 1891, by Lieut. Col. G. L. Gillespie, Corps of Engineers.

Material, etc.	1. William Parrott.	
	Price per unit.	Amount.
White-oak piles, 450 linear feet	$0.30	$135
Pine or spruce piles, 11,500 linear feet	.13	1,495
Square timber, 9,500 feet B. M	40.00	380
Tie-rods and screw-bolts, 7,000 pounds	.04½	315
Driftbolts, spikes, washers, chain or cable, 500 pounds	.04	20
Rubblestone, 1,000 cubic yards	1.20	1,200
Total amount		3,545

COMMERCIAL STATISTICS.

The commercial statistics of this harbor have not changed materially since Report for 1890, at which time there was a total tonnage of 2,467,490 tons, valued at $41,268,850. General merchandise, coal, cement, lime, bluestone, and ice are the principal products handled, and are carried in about 700 vessels, which also carry 75,000 passengers annually.

Of the above tonnage one-half passes through the Delaware and Hudson Canal, which connects the Hudson River at Rondout with the Delaware River at Port Jervis, N. Y., and with Honesdale, Pa., the heart of the Pennsylvania coal region.

The population of Rondout is 25,000.

E 4.

IMPROVEMENT OF WAPPINGER CREEK, NEW YORK.

Wappinger Creek is a small stream which rises in the northern part of Dutchess County, N. Y., near the boundary with Columbia County, and after flowing for about 40 miles through a rich, fertile valley, empties into the Hudson River, on the east bank, one-half mile below the village of New Hamburg, N. Y.

The appropriation of $13,000 contained in the river and harbor act of September 19, 1890, is the first ever made by the Government for the improvement of the stream, and is based upon the estimate contained in the report, November 11, 1889, upon the survey of Wappinger Creek from Wappinger Falls to its mouth, made to comply with the river and harbor act of August 11, 1888.

At the time of the survey the creek was navigable for vessels and small barges drawing not over 6 feet in a channel varying in width from 25 feet to 75 feet to Wappinger Falls, 2 miles approximately above its mouth, where a series of falls, with an aggregate height of 86½ feet above mean low water, furnish a valuable water-power for three industries, the principal of which is the print works of the Dutchess Company.

The project of improvement contemplated a channel 80 feet wide and 8 feet deep from the mouth to the head of navigation at the Falls, and the quantity of material required to be excavated was estimated at 45,000 cubic yards.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

The river and harbor act of September 19, 1890, appropriated for the improvement of this creek the sum of $13,000, the full amount of the estimated cost of the project.

Sealed proposals for dredging a channel 80 feet wide and 8 feet deep at mean low water, from the Dutchess Print Company's Coal Dock to the railroad drawbridge, near the mouth of the creek, which were invited by public advertisement according to law June 8, 1891, were opened July 16, 1891, and the contract awarded to P. W. Myers, the lowest bidder, August 5, 1891, at 23 cents per cubic yard.

According to the proposal the contractor agreed to build a substantial bulkhead, within the limits of the creek, to hold and confine what material was dumped in the creek. Accordingly, the contractor built a bulkhead running east a distance of 600 feet from the point of rock on the west shore, just below Millards Coal Wharf, and put a dredge behind this and made room for the material to be dumped.

On September 12, 1891, he started with one dredge, and began digging at the upper end of creek, working downstream.

Work was continued until December 26, 1891, when, on account of cold weather, it was suspended for the season. Up to this time he had removed 35,257 cubic yards of material, all of which was dumped in the creek behind the bulkhead.

On April 2, 1892, the contractor resumed work, and completed his contract April 30, the specified date of its expiration. During the spring he removed 14,743 cubic yards, making a total of 50,000 cubic yards for the year. Some of this material was hauled to Fishkill and dumped in the cove south of the New York and New England Ferry Slip.

To give additional commercial facilities at the head of navigation, a channel 40 feet wide and 8 feet deep was also dredged from deep water in the creek to the Wappinger Town Dock. The channel is now in good navigable condition, 80 feet wide and 8 feet deep, according to the specifications, sufficient for all the wants of commerce.

The amount expended during the fiscal year ending June 30, 1892, inclusive of outstanding liabilities, was $12,756.82.

As the approved project has been completed, no further appropriation is recommended for this improvement.

Wappinger Creek is in the collection district of New York. The nearest works of defense are situated upon Governors Island, New York Harbor, and the nearest light-house is the Danskammer Point Light-House.

AMOUNT APPROPRIATED.

September 19, 1890	$13,000.00
Amount expended to June 30, 1892, inclusive of outstanding liabilities	12,837.65

Money statement.

July 1, 1891, balance unexpended	$12,919.67
June 30, 1892, amount expended during fiscal year	12,756.82
July 1, 1892, balance unexpended	162.85

COMMERCIAL STATISTICS.

The principal manufactures at the Falls are cotton goods, overalls, clothing, combs, and iron. They are mostly transported by small boats to the mouth of the creek inside of the railroad bridge, where they are transferred to the New York Central and Hudson River Railroad.

The tonnage of the creek during the year 1888 was 70,000 tons. The value of the tonnage was then estimated at $6,500,000. The Dutchess Company shipped 15,500 tons at an estimated valuation of $5,600,000. The traffic is principally carried by sloops, schooners, scows, canal boats, and barges.

E 5.

IMPROVEMENT OF HARLEM RIVER, NEW YORK.

The project for making a navigable water connection between the East River and the Hudson River by the way of the Harlem River and Spuyten Duyvil Creek was formulated upon the facts determined by the survey made along this route in 1874, in compliance with the river and harbor act of June 23, 1874, the report upon which may be found on page 224, Annual Report of the Chief of Engineers for 1875, Part II.

This report contains an interesting historical review of the navigation of the Harlem River from the revolution to the present time.

A full history of this improvement as now adopted, with the legal proceedings for the acquirement of the land needed for it and copies of the laws passed by the legislature of the State of New York relative thereto, is given in the annual report of the local engineer in charge to the Chief of Engineers for 1887. (See Annual Report of the Chief of Engineers for 1887, Part I, pages 665 to 689.)

The streams embraced in the improvement are the Harlem River and the Spuyten Duyvil Creek, the former emptying into the East River near Hell Gate, and the latter into the Hudson River about 13 miles north of the Battery, and the two together separating Manhattan Island from the mainland.

There has always been an exchange of waters between these two streams at Kingsbridge, though a long ledge of rocks awash at mean low water and an extremely narrow channel at that point have heretofore prevented the exchange being a free one.

High Bridge is practically at the head of navigation in the Harlem River, but there is a fair channel of about 10 feet depth at mean low water as far as Morris Dock, 6 miles from the mouth of the river, and a crooked one of 7 feet depth to Fordham Landing, 1 mile farther; but there is no navigation of this latter section, except by rowboats or by small boats used for transporting building material to the "annexed district." Kingsbridge, 1¾ miles from the Hudson River, is the head of navigation in the Spuyten Duyvil Creek, but only at high water for vessels drawing 8 feet.

The range of the tides in Harlem River varies from 5.5 feet at Third Avenue Bridge to 6 feet at the mouth of Dyckman Creek, and in the Spuyten Duyvil Creek is 3.8 feet.

As the difference in the height and times of tides between the East and Hudson rivers, after connection has been made between the Harlem and the Hudson rivers, will produce the currents upon which reliance is placed to keep the channel open, it is desirable that the cross-section of the channel be kept as uniform as possible, in order to avoid the unnecessary resistances to the flow of the water which would be caused by any contraction of the waterway.

With this view the contraction of the proposed cut through Dyckman Meadow will be more than counterbalanced by the natural channel through Spuyten Duyvil by the way of Kingsbridge, which is left open, and the contraction caused by the piers and embankments of the High Bridge, which carries the Croton Aqueduct across the Harlem River, should be compensated for by deepening the channels between the piers and abutments of that bridge.

Observations of the tides affecting these waters show that there is not a free exchange of tides between Harlem River and Spuyten Duyvil Creek, but that there is practically a divide somewhere near Fordham Bridge between the tides flowing from the East River into the Harlem River and from the Hudson River into Spuyten Duyvil Creek. Comparing the tides of the Harlem River at Fordham Bridge with those of the Hudson River at the mouth of the Spuyten Duyvil Creek it is found—

(1) That the level of mean high water in the Hudson is nearly 1 foot (.961 foot) lower than it is in the Harlem.

(2) That the mean rise and fall of the tide in the Hudson is 2.12 feet less than it is in the Harlem.

(3) That the mean duration of the rise of tides in the Hudson is thirty-six minutes shorter, and the mean duration of the fall twenty-six minutes longer than in the Harlem.

(4) The mean level of the Hudson at the mouth of the Spuyten Duyvil Creek is .265 of a foot lower than at Fordham Bridge.

(5) High water occurs one hour and thirty-four minutes earlier in the Hudson than in the Harlem.

From these facts it follows that while on the opening of the new channel through Dyckman Meadow there will be a free flow east or west, dependent upon the stage of the tides, the preponderance will be westward, and that the mouth of the improved channel will then be at the junction with the Hudson River.

The project for the improvement was adopted in 1879. The proposed lines of improvement, as laid down by the engineer in charge in his Annual Report for 1882, are as follows:

(1) Below the Harlem or Third Avenue Bridge the outer pier and bulkhead lines as laid down by the park department are adopted.

(2) Above the Third Avenue Bridge to the entrance of Dyckman Creek into the Harlem River, the exterior pier and bulkhead lines are laid down 400 feet apart.

(3) The line following Dyckman Creek through Dyckman Meadow will pass for a part of the way through solid rock, and it is here that the principal cost of the undertaking must be encountered. This part is to be made 350 feet wide. It would have been preferable to have established it at 400 feet, but the additional amount of rock excavation was the obstacle.

(4) The remainder of the line to the Hudson River will follow as nearly as possible the course of the Spuyten Duyvil, and the width will be 400 feet.

(5) The channel depth in the Harlem River and Spuyten Duyvil Creek will be 15 feet at mean low water, and in the channel along Dyckman Creek 18 feet, mean low water.

The cost of opening a navigable waterway from the Hudson River, through Dyckman Creek, to the Harlem River at East Two hundred and eighteenth street, New York City, was estimated in 1875 at $2,100,000, and for dredging the Harlem River thence to Third avenue at $600,000 additional, making the estimated aggregate cost of the improvement $2,700,000.

The project was revised in 1886, by narrowing the channel immediately north of High Bridge to 375 feet where it skirts the Ogden estate on the east bank. This change of width was approved by the Secretary of War October 7, 1886. (See Annual Report of the Chief of Engineers for 1887, Part 1, page 671.)

The legal difficulties for acquiring the right of way along the line of the proposed improvement, from the Harlem River to the Hudson River, through Dyckman Meadow, were removed in May, 1887, and immediately thereupon the appropriations of 1878 and 1879, aggregating

$400,000, became available, and the project for their expenditure was begun and continued under appropriations of 1888 and 1890.

The contracts in force provide for the excavation of all the material contained between the dams; the removal of the dams; the revetment of both banks for short distances east and west of both dams; and for dredging a channel from the east dam through the Harlem River to Fordham Dock, and from the west dam to Spuyten Duyvil Creek. It is expected that when these contracts are completed there will be a narrow channel between the Hudson and the East rivers, navigable at mean low water by vessels drawing 8 feet.

By act of Congress approved March 3, 1881, a survey was made of the Harlem or Bronx Kills, north of Randall Island, and a report was submitted upon the practicability of opening a channel 300 feet wide and 15 feet deep, mean low water, between the East River and the Harlem River, by this route, at an estimated cost of $2,000,000. The report will be found in the Annual Report of the Chief of Engineers for 1882, Part 1, page 656. The project was never approved by Congress and no appropriation has ever been made for its execution.

Harbor lines for the preservation and protection of the navigable waters of the Harlem River and Spuyten Duyvil Creek were established by the Secretary of War October 18, 1890, under authority of the river and harbor act of August 11, 1888.

BRIDGES ACROSS THE HARLEM RIVER.

The following table shows the location and characteristics of the several existing bridges across the Harlem River:

Name and location of bridges.	Width in clear in each draw.	Height of bottom chords above mean high water.	Remarks.
	Feet.	*Feet.*	
Second Avenue	103.7	28.5	Double draw, railroad bridge, iron.
Third Avenue	82	13.8	Double draw, road bridge, iron.
Fourth Avenue	65 68	7.2	Double draw, railroad bridge, iron.
Madison Avenue	132	28	Double draw, road bridge, iron.
McCombs Dam	80	36.7	Double draw, road bridge, wood and iron; soon to be reconstructed.
New York and Northern Railway Bridge.	128	28	Double draw, railroad bridge, iron.
High Bridge (Old Aqueduct).			No draw; width in clear between piers, 77.7 feet; intrados of arch, 100 feet above mean high water.
Washington Bridge at One hundred and eighty-first street.		Single span.	No draw; iron arch; clear span, 500 feet; crown of arch, 136.7 feet above mean high water.
Footbridge, Fordham	32	3.9	Single draw; wooden trestle; soon to be removed.
Farmers Bridge		3.1	No draw; 2 spans, 22 and 23 feet wide.
Kings Bridge		4.8	No draw; 2 spans, 18 and 25 feet wide.
Hudson River Railroad Bridge, mouth of Spuyten Duyvil Creek.	26.2	1.4	Single draw; wooden trestle; soon to be provided with a draw opening 50 feet wide and a steam motor for operating drawbridge.

BRIDGES AT OTHER POINTS AFFECTED BY STATE ACTS PASSED DURING THE YEAR, OR BY NOTICES SERVED BY THE SECRETARY OF WAR.

(1) *Bridges at Third and Fourth avenues, New York City.*—The city of New York, owning or controlling the bridge at Third avenue, and the New York Central and Hudson River Railroad Company, owning

or controlling the bridge at Fourth avenue, were notified by the Secretary of War, July 2, 1890, to modify these bridges in accordance with the recommendations of the Board of Engineers convened May 7, 1890, to consider, as stated in the Annual Report for 1890, the matter of bridges across the Harlem River at Third and Fourth avenues, New York City. These notices required that the modifications called for should be completed by January 1, 1892.

Up to the present time no changes have been made in either of these bridges. At the last session of the legislature of the State of New York, however, an act to authorize and require an increased elevation of the Fourth Avenue Bridge, and to provide for all changes in any avenues, streets, and railroads that may be necessary by reason of such increased elevation was passed, and received the approval of the governor April 5, 1892. A commission to carry out the provisions of this act was appointed by the mayor of New York City April 25, 1892. This act will enable the railroad company to reconstruct this bridge in conformity with the requirements of the notice of the Secretary of War, which, in the absence of the necessary legislative action, the company has not heretofore been able to carry out. Plans for the new bridge have been submitted for the approval of the Secretary of War.

In order that traffic across the river may not be suspended while the permanent bridge is in process of construction, the railroad company applied to the Secretary of War for authority to build a temporary bridge, provided with a 60-foot draw and situated 160 feet to the northward of the old bridge. This application was granted May 27, 1892.

An act to provide for the reconstruction of the Third Avenue Bridge was approved by the governor of the State of New York May 2, 1892, and plans for the construction of the new bridge are now being prepared by the department of public works of New York City.

2. *Bridge at Broadway Crossing.*—An act of the legislature of the State of New York, to provide for the construction of a bridge across the Harlem Ship Canal, locally so called, on the line of Kingsbridge road, or Broadway extended, was approved by the governor April 5, 1892. Plans for the construction of this bridge, conforming to the general provisions of the State act of 1879 as to height of lower chord and length of spans, prepared by the department of public works of New York City, have been submitted to the Secretary of War for approval.

3. *Macomb Dam Bridge.*—The State act of April 29, 1890, authorizing the department of public parks of New York City to reconstruct the Macomb Dam Bridge at Seventh avenue was amended by a bill which became a law without the signature of the governor January 31, 1892. The amendment provides that the awards for property taken shall not be paid out of the $1,250,000 appropriated for the bridge. This bridge is now in process of construction under plans approved by the Secretary of War September 7, 1891. The shore span of the old bridge, on the south side of the river, and also the south rest pier of the old draw, have been removed, and the site of the center pier, as well as that of the south rest pier of the new drawspan, prepared for the caissons by dredging down to bed rock, and the caissons for these piers will shortly be sunk. The masonry of the south abutment is also nearly completed.

Application was made by the city of New York, June 14, 1892, for authority to build a temporary bridge 220 feet to the northward of the old bridge, to be used by the public during the construction of the new bridge. This application has not yet received the approval of the Secretary of War.

4. *Bridge at Mouth of Spuyten Duyvil Creek.*—As stated in the last annual report, Mr. Alexander J. Howell, on March 4, 1891, made complaint to the Secretary of War that the railroad bridge across the Spuyten Duyvil Creek at its mouth was an obstruction to navigation by reason of "insufficient width of draw," under the river and harbor act of September 19, 1890.

The matter was referred to the local officer, and two public hearings were given to the parties in interest.

The complaint was satisfied by the New York Central and Hudson River Railroad Company agreeing, as a temporary measure only, to widen the draw opening to 50 feet and to erect a steam motor with which to maneuver the drawbridge. This agreement was approved by the Secretary of War June 9, 1891, with the proviso that the modifications agreed upon should be regarded as a temporary measure to meet the necessities of the navigation of the stream as they now exist, and the date fixed for completion of the alterations was December 1, 1891.

Owing to various delays in the preparation of the plans and in letting the work, and further delays on the part of the contractor, the work of erecting the new draw was not begun until April, 1892. The work is now well advanced, and the new draw will be in operation about August 1, 1892.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

At the beginning of the year three contracts were in force with John Satterlee, one with Lee McCallum, and one with P. Sanford Ross.

The first of Mr. Satterlee's contracts, dated December 15, 1887, calls for the removal of 300,000 cubic yards of material from the cut through Dyckman Meadow; the second, dated August 12, 1889, for the removal of 71,000 cubic yards of earth and 19,000 cubic yards of rock, for building an earthen and timber dam to shut out the water of the Harlem River from the site of the work to be done under this contract, and for the construction of timber revetments to protect the sides of the section of canal prism to be excavated; and the third, dated March 9, 1891, for excavating and removing about 37,000 cubic yards of rock and 7,000 cubic yards of earth from the section of canal prism lying between the two former contracts.

The contract with Lee McCallum, dated December 29, 1890, calls for removing the eastern cofferdam, containing about 30,000 cubic yards of earth, stone, and timber work; for dredging 180,000 cubic yards, more or less, of earth and mud from the shoal reach in the Harlem River between the easterly limit of the cut through Dyckman Meadow and Fordham footbridge; and for constructing about 350 linear feet of crib work and about 200 linear feet of pile-work revetment for the protection of the sides of the section of cut to be excavated.

The contract with P. Sanford Ross, dated January 19, 1891, calls for removing the western cofferdam, containing about 40,000 cubic yards of earth, stone, and timber work; for dredging about 160,000 cubic yards of mud and earth from the meadow and creek bed west of the dam, and for constructing about 300 linear feet of crib work and 250 linear feet of pile-work revetment for the protection of the sides of the section of cut to be excavated.

Under authority granted by the Chief of Engineers, June 18, 1890, an open-market agreement was also in force with John Satterlee for the construction of about 2,870 cubic yards of stone-revetment wall for the protection of side slopes in the westerly end of the cut through

Dyckman Meadow, the wall to be built of stone taken from the excavation, and to be laid partly dry and partly in cement mortar, as circumstances might require.

Another agreement, supplementary to the contract of December 15, 1887, and dated March 12, 1891, for the removal of mud and meadow sod which had been washed into the west end of the Dyckman Cut through a breach in the west dam, was also in force.

The first contract with Mr. Satterlee, dated December 15, 1887, expired by limitation on September 30, 1891, and was closed on that date. The second contract, dated August 12, 1889, expired on December 1, 1891, and the third, dated March 9, 1891, expired on January 31, 1892. On the application of the contractor both of the latter contracts were extended by direction of the Chief of Engineers to July 30, 1892.

The open-market agreement for the construction of stone revetment wall, approved June 18, 1890, was closed on April 1, 1892, the amount of wall called for being completed; and another agreement for the construction of about 800 additional cubic yards of wall, mostly in the easterly end of the cut, was entered into on April 19, 1892, with B. F. Deniston, attorney for the administrators of John Satterlee, deceased, at the same prices paid under the first agreement, viz, $2.50 per cubic yard for dry stone wall and $6 per cubic yard for wall laid in mortar.

The contract with P. Sanford Ross, dated January 19, 1891, expired on January 31, 1892, and, on application of the contractor, was extended by direction of the Chief of Engineers to December 30, 1892.

It was expected that all the work between the dams would be completed during the summer or autumn of 1892, and that the removal of the dams inclosing the excavation could then be undertaken. On April 25, 1892, however, a communication was received from the commissioner of public works, New York City, informing this office that the construction and completion of the bridge which the city was about to build over the cut on the line of New Broadway could not be assured earlier than November, 1893, and that consequently the removal of the dams, as above indicated, would break all connection between the sections of the city north and south of the canal for at least one year, and as the breaking of this connection on the only thoroughfare in that section of the city would work great injury to public interests and convenience, the commissioner expressed the hope that, as a concession to the public and private interests involved, and as a courtesy to the city of New York, the United States authorities would consent to the continuance of the present temporary roadway across the canal which passes over the east dam until the city could finish the bridge.

As the benefits to commerce to be derived by a removal of the dams and the establishment of water communication between the Harlem River and Spuyten Duyvil Creek will be deferred only for a comparatively short period, while a saving to the city of about $100,000 will be effected by building the bridge piers under the protection of the dams, it was decided for these, or for the other above stated reasons, to recommend that the request of the city of New York, expressed through the commissioner of public works, be granted, and that the removal of the dams be deferred until the bridge is finished. But as the contracts in force with Lee McCallum and P. Sanford Ross included the removal of the dams, and the construction of shore revetments on both sides of the cut after the dams are removed, it became necessary either to extend the time for the completion of these contracts at least one year beyond the date fixed for their completion or to so modify them, with the consent of the contractors, that the funds yet to be expended under the contracts could be applied to extend the dredging in Harlem River and Spuyten Duyvil Creek, east and west of the dams, in accordance with the approved project. The latter measure was favored, as a channel 9 feet deep at mean low water and about 150 feet wide could thus be provided from the Hudson to the Harlem River, which would become available on the removal of the dams, while, without the additional dredging, only about 8 feet depth in a narrow channel could be provided.

The request of the city was granted by the Secretary of War June 13, 1892, and, with the approval of the Chief of Engineers, supplementary articles of agreement were accordingly made to the contracts, dated December 29, 1890, and January 29, 1891, respectively, providing for 135,000 cubic yards of additional dredging under Mr. McCallum's contract, and for 120,000 cubic yards of additional dredging under Mr. Ross's contract, at the same prices paid for dredging under the original contracts.

Under the foregoing contracts and agreements the following work was done during the fiscal year:

Rock and earth excavated between dams.

[Under contract dated December 15, 1887.]

	Contract quantity.	Removed during fiscal year.	Removed prior to June 30, 1891.	Total removed under contract.
	Cubic yards.	*Cubic yards.*	*Cubic yards.*	*Cubic yards.*
Above mean low water	300,000	807	126,469	127,276
Below mean low water		10,036	163,491	173,527
Total	300,000	10.843	289,960	300,803

Of the above total 201,294 cubic yards are rock and 99,509 cubic yards earth.

Under the supplementary agreement to this contract, dated March 12, 1891, 703 cubic yards of mud and meadow sod were removed, making a total of 10,209 cubic yards removed under this agreement.

[Under contract dated August 12, 1889.]

	Contract quantity.	Removed during fiscal year.	Removed prior to June 30, 1891.	Total removed under contract.
	Cubic yards.	*Cubic yards.*	*Cubic yards.*	*Cubic yards.*
Rock excavation	19,000	7,375	398	7,773
Earth excavation	39,000	6,650	46,379	53,029
Earth dredging	32,000	....	11,000	11,000
Total	90,000	14,025	57,777	71,802

[Under contract dated March 9, 1891.]

Rock excavation	37,000	21,845	2,089	23,934
Earth excavation	7,000	2,345	5,593	7,938
Total	44,000	24,190	7,682	31,872

DREDGING.

Under the contract of December 29, 1890, with Lee McCallum, dredging operations in the Harlem River were continued from June 30 to August 25, 1891, when the dredging plant was temporarily withdrawn, permission having been granted the contractor to suspend operations pending the construction of a bulkhead behind which to deposit the balance of the material to be removed under the contract.

Dredging was resumed on May 12, 1892, and is still in progress.

Under the contract with P. Sanford Ross, dated January 19, 1891, operations were begun on July 20 and continued to December 22, 1891, when the dredging plant was temporarily withdrawn until the removal of the west dam could be undertaken, the dredging having approached the dam as close as it was deemed advisable to dredge with safety to the dam.

The following table shows the work done under the above contracts during the year:

Location.	Contract quantity.	Removed during fiscal year.	Removed prior to June 30, 1891.	Total removed under contract.
Contract with Lee McCallum.	*Cubic yards.*	*Cubic yards.*	*Cubic yards.*	*Cubic yards.*
Harlem River	245,000	150,315	40,204	190,519
East Cofferdam	30,000			
Contract with P. Sanford Ross.				
Spuyten Duyvil Creek	160,000	82,420		82,420
West Cofferdam	40,000			

STONE AND TIMBER REVETMENTS.

Under the open market agreements approved June 18, 1890, and April 19, 1892, 1,152 cubic yards of dry stone wall, and 2,095 cubic yards of wall laid in mortar, were built during the year, making a total of 1,715 cubic yards of dry stone wall, and 2,224 cubic yards of wall laid in mortar, built to date.

The wall built is in five detached sections, two of which are located in the west end of the cut, two in the east end, and one near the middle, on the north side. They have a combined length of 625 feet, and vary from 27 to 30 feet in height.

Under the contract, dated August 12, 1889, about 100 linear feet of crib-work revetment, and 90 feet of pile-work revetment were built. These revetments adjoin the east dam, on the north and south sides of the cut, and connect with the easterly ends of the stone retaining walls located there.

The work in the rock cut was continued during the year without interruptions, excepting such as were occasioned by stormy weather, or accidents to the working plant, etc. The cofferdams have been materially strengthened, and the leakage through them is now comparatively slight, and although the area of the excavation has been greatly increased, and many new springs have developed, both the surface drainage and the leakage coming into the work can be easily controlled by the two pumps available for this purpose.

As the result of the year's work the excavation of the section of canal prism lying between the two dams was carried down to grade over an area of 79,425 square feet, giving a total area of 285,000 square feet where the excavation has reached grade, leaving an area of only 65,000 square feet over which the rock remains to be excavated in order to complete the cut between the dams, and much of this rock has already been reduced to within a few feet of grade. All of the revetment wall necessary to protect the side slopes of the canal chamber and prevent the loose rock and earth arising from degradation of the banks from falling into the cut after the canal has been opened to navigation has been built, with the exception of a section about 100 feet in length on the north side near the eastern end, which is now in process of construction.

In the Harlem River a channel 9 feet deep, mean low water, and about 150 feet wide, has been dredged from a point 900 feet north of Fordham Foot Bridge, where it connects with the natural channel, to within 200 feet of the East Dam.

In Spuyten Duyvil Creek the channel near the Hudson River Railroad Drawbridge has been widened to about 65 feet, with a depth of 8 feet, mean low water; the channel over the bar at the Rolling Mill deepened to 8 feet, mean low water; the point of meadow opposite the Government Dock cut off so as to widen the channel at this point to 240 feet; and Dyckman Creek and the meadow in front of the West Dam has been excavated to nearly the full projected width and depth to within 100 feet of the West Dam.

The amount expended during the fiscal year ending June 30, 1892, inclusive of outstanding liabilities, was $190,421.14.

This improvement can not be well or economically conducted except under large appropriations. The amount that can be profitably expended during the fiscal year ending June 30, 1894, is $500,000.

A full statement of the commerce likely to be benefited by the improvement is subjoined.

Mr. A. Doerflinger, assistant engineer, has been in local charge of this improvement during the year. He has remained constantly upon the work, and has discharged his duties with his accustomed fidelity and efficiency.

Harlem River is in the collection district of New York. The nearest light-house is on Blackwells Island.

AMOUNTS APPROPRIATED.

June 23, 1874, allotment from appropriations for East and Harlem Rivers	$11,000.00
By act of Congress approved:	
March 3, 1875	10,000.00
June 18, 1878	300,000.00
March 3, 1879	100,000.00
August 11, 1888	70,000.00
September 19, 1880	250,000.00
	741,000.00
Amount expended to June 30, 1892, inclusive of outstanding liabilities	589,122,19

Money statement.

July 1, 1891, balance unexpended		$342,298.95
June 30, 1892, amount expended during fiscal year		152,161.66
July 1, 1892, balance unexpended		190,137.29
July 1, 1892, outstanding liabilities	$38,259.48	
July 1, 1892, amount covered by uncompleted contracts	142,204.41	
		180,463.89
July 1, 1892, balance available		9,673.40
Amount appropriated by act approved July 13, 1892		175,000.00
Amount available for fiscal year ending June 30, 1893		184,673.40

Amount (estimated) required for completion of existing project	$1,805,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

As there is no navigable communication between the Harlem River and Spuyten Duyvil Creek, the present navigation of the Harlem River is practically confined to that part of the stream between its junction with the East River and Satterlee's Dock at foot of Two hundred and twentieth street, a distance of about 8 miles.

Spuyten Duyvil Creek is navigable from its junction with the Hudson River to Kingsbridge, a distance of 1¼ miles.

The actual commerce of the Harlem River and Spuyten Duyvil Creek for the fiscal year ending June 30, 1889, and June 30, 1890, was as follows:

Items.	1889.	1890.	
	Tons.	*Tons.*	*Value.*
General merchandise	1,259,516	1,379,334	$93,114,135
Grain, flour, etc	341,167	400,987	11,325,607
Lumber	292,500	346,858	5,866,283
Building material	535,766	642,922	2,287,600
Fuel	523,290	506,363	2,464,800
Ice	131,700	112,000	448,000
Total	3,093,939	3,384,466	115,506,425

The total tonnage for the year 1890 shows an increase over that of 1889 of 290,527 tons, or over 9 per cent.

The total tonnage for the year 1887 was given at 2,524,155 tons, showing an increase in the present tonnage over that of 1887 of 860,311 tons, or 34 per cent in the three years.

Of the total tonnage for 1890, 1,407,882 tons were received at and shipped from the docks of the New York, New Haven and Hartford Railroad Company, directly below Second Avenue Bridge, and 246,402 tons were handled by the New York and Northern Railway Company at their docks near High Bridge. Of the balance, 1,709,632 tons were distributed among the various docks on the Harlem River between Ninety-second street and Fordham Heights, and 20,550 tons at various points on the Spuyten Duyvil Creek.

A large proportion of the freight handled at the railroad docks is carried in and out of the Harlem on railroad car floats and transfer boats connecting the railroads of the New Jersey and Pennsylvania terminating at Weehawken, Hoboken, and Jersey City with those of New England, while the general commerce of the river is carried on mainly in barges and canal boats in tow of steam tugs and in schooners and the smaller class of sailing vessels.

During the past two years new docks have been built between Fourth and Madison avenue and directly above Madison Avenue Bridge on the south side of the river. These docks have a combined river frontage of about 1,400 feet, and are mainly occupied by dealers in brick and building materials. Most of the material received by them is carried in schooners and barges and enters largely into the construction of the numerous buildings being erected in this rapidly developing section of the city. Extensive docks have also just been completed on the north side of the river between the entrance to Cromwell Creek and One hundred and fiftieth street, covering about 2,000 feet of river front. With this expansion of dockage facilities, and rapid development of new industries along the line of the river, the increase in tonnage during the year 1892, so far as can be learned from present investigation and inquiries, has been fully up to the average increase during the last four years, indicating a present annual tonnage of over 4,000,000 tons.

CHAP. 232.—AN ACT to provide for the construction of a bridge over the Harlem Ship Canal in the city of New York.

[Approved by the governor April 5, 1892. Passed, three-fifths being present.]

The people of the State of New York, represented in senate and assembly, do enact as follows:

SECTION 1. The commissioner of public works of the city of New York is hereby authorized to erect and construct of stone, iron, or steel, or one or more of these materials, a suitable bridge and approaches thereto, with the necessary abutments and arches over adjacent streets or avenues for the passage of persons, animals, vehicles, and traffic across the Harlem Ship Canal in said city on the line of the road or thoroughfare knows as Kingsbridge road or Broadway, at such points on said road or thoroughfare as the said commissioner shall ascertain and determine to be practicable, and to make such changes in the grade line of streets or avenues approaching said bridge as may be necessary to carry out the purpose of this act and for the proper construction of the improvement hereby authorized. Said bridge shall not be less than fifty feet in width for passage, and the grade thereof shall be at such an elevation as shall be required by the acts of Congress of the United States in relation to said ship canal, but not less than twenty-six feet above mean high-water mark of said ship canal, and shall be otherwise constructed in conformity with the general provisions of law contained in section six hundred and seventy-six, chapter thirteen, of chapter four hundred and ten of the laws of eighteen hundred and eighty-two, regulating the construction of bridges over the Harlem River and Spuyten Duyvil Creek. Said bridge shall be free for the passage of persons, animals, vehicles, and traffic, and when completed shall be kept and maintained in good order and repair by the department of public works in said city: *Provided, however,* That nothing shall be done under this act until the plans and specifications for the said bridge and approaches thereto, with the necessary abutments and arches as aforesaid, as well as the proposed changes hereby authorized in the grade lines of the streets or avenues approaching the said bridge shall have been submitted to and approved by the board of estimate and apportionment of said city.

SEC. 2. The said commissioner of public works shall, upon such approval by the board of estimate and apportionment, proceed to construct the said bridge and approaches thereto, with the necessary abutments and arches as aforesaid, and the same shall be completed within three years from the time of such approval. The work of constructing said bridge and approaches thereto, with the necessary abutments and arches as aforesaid, and the furnishing of all the material and labor necessary therefor, shall be done by contract or contracts made at public letting to the lowest bidder or bidders, pursuant to the general provisions of law and ordinance regulating the letting of contracts in said city.

SEC. 3. The expense of constructing said bridges and approaches thereto, with the necessary abutments and arches as aforesaid, shall not exceed four hundred thousand dollars, and such further sum for paying awards for damages caused by reason of the change of grade of streets or avenues approaching the same, authorized by this act, as may be awarded by the board of assessors of the said city, whose duty it shall be to estimate the damage which each owner of land fronting on such street or avenue will sustain by reason of such change to such land, or to any improvement thereon, and make a just and equitable award to the amount of such damage to the owner or owners of such lands or tenements fronting on such street or avenue, and opposite thereto, and affected by such change of grade. The comptroller of said city shall, from time to time, when directed by the board of estimate and apportionment, prepare and issue bonds of said city, bearing interest at not more than four per centum per annum, and redeemable from time to time, but not less than twenty years after the date thereof, for the purpose of defraying the expense of constructing the said bridge and approaches thereto, with the necessary abutments and arches as aforesaid, and for paying the awards which may be made for damages by reason of any change of grade as aforesaid. Such bonds shall not be sold for less than the par value thereof, and the moneys received from the sale of the said bonds shall be deposited in the treasury of the said city, and shall be drawn and paid by the comptroller of the said city for the several objects and purposes provided in this act, upon vouchers in a form to be prescribed by the said comptroller.

SEC. 4. With the consent and approval of the board of estimate and apportionment first had and obtained, the commissioner of public works, for and in behalf of the mayor, aldermen, and commonalty of the city of New York, is hereby authorized to acquire title in fee to any land which he may deem necessary for the purpose of the construction of the said bridge and approaches with the necessary abutments or arches as aforesaid, and to that end, the said commissioner may make application to the supreme court in the first judicial district for the appointment of commissioner of estimate, specifying in such application, the lands sought to be acquired for the purpose aforesaid. The provisions of law relating to the taking of private property for public streets or places in the said city, are hereby made applicable as far as may be necessary, to the acquiring of the said land as aforesaid. The amount or amounts awarded for the said land and the expense of the proceedings hereby authorized for the acquiring of the same shall form part of and be included within the expense of constructing the said bridge and approaches thereto, with the necessary abutments and arches authorized by the third section of this act.

SEC. 5. This act shall take effect immediately.

CHAP. 339.—AN ACT to regulate, improve, and enlarge Park avenue above One hundred and sixth street, in the city of New York, and providing for the passage of intersecting streets under the railroad structure of the New York and Harlem Railroad Company, and for the elevation of said railroad structure, and for changing the grade of said railroad, and for the construction of a new railroad bridge at an increased elevation over the Harlem River, and providing for all changes in any avenues, streets, or railroads that may be necessary by reason of such change in structure and grade and increased elevation of bridge, and for other purposes.

[Approved by the governor April 19, 1892. Passed, three-fifths being present.]

The people of the State of New York, represented in senate and assembly, do enact as follows:

SECTION 1. The grade of the New York and Harlem Railroad between One hundred and sixth street and the Harlem River, as now established by chapter seven hundred and two of the laws of eighteen hundred and seventy-two, shall be changed and altered as follows: Commencing at or about One hundred and sixth street, the grade shall ascend going northwardly at the rate of forty feet per mile to One hundred and sixteenth street; and thence the grade shall descend, going northwardly, at the rate of twenty-four and seven-tenths feet per mile to One hundred and twenty-ninth street; thence, still descending northwardly at the rate of twenty-nine and six-tenths feet per mile, to a point about eighty feet southwardly from the present legally established bulkhead line on the south side of the Harlem River; thence, going northwardly, the grade over the Harlem River shall be level at an elevation of twenty-six feet above high-water line of spring tides, to a point about eighty feet north of the present legally established bulkhead line on the north side of the Harlem River; thence, descending on a grade of not exceeding thirteen feet per mile, to a point twenty feet south of the south line of One hundred and thirty-eighth street; thence, still descending northwardly on a grade of not exceeding thirty-seven feet per mile, to the south line of One hundred and forty-fourth street; thence, still descending on a grade not exceeding twenty-nine feet per mile to the level of the roadbed of the New York and Harlem Railroad, as now legally established and constructed, at or about the south line of One hundred and forty-ninth street.

2. The viaduct structure, as it now exists between One hundred and sixth and the south side of One hundred and eleventh streets, shall be adapted to the new grade line as established by the preceding section by raising its parapet walls, and filling in with earth or other materials between the same to the height required by the new grade; and from the south side of One hundred and eleventh street to the Harlem River, the railroads tracks and roadbed shall be carried on a viaduct structure of iron or steel, or of both of these materials combined, consisting of three lines of plate girders, supported on columns of iron or steel, standing on suitable pedestals of stone or brick masonry, with foundations under the same of timber piling or concrete, as may be found necessary.

3. The present depressed cut of the railroad extending from One hundred and fifteenth street to One hundred and thirty-third street shall be filled in with earth or other suitable material, and its parapet walls taken down below the line of the under side of the avenue paving; and the bridge which now carries One hundred and sixteenth street, the roadway between One hundred and seventeenth and One hundred and eighteenth streets; the bridges which carry One hundred and nineteenth, One hundred and twentieth, One hundred and twenty-first, One hundred and twenty-second, One hundred and twenty-third, One hundred and twenty-fourth, One hundred and twenty-fifth, One hundred and twenty-sixth, One hundred and twenty-seventh, One hundred and twenty-eighth, and One hundred and twenty-ninth streets over the said depressed cut, also the foot bridges over the same at One hundred and thirtieth and One hundred and thirty-first streets shall be removed, and the space between the exterior lines of the said parapet walls shall form a part of Park avenue, and be paved with stone paving of the same character and description as Park avenue is now paved, and shall be laid in accordance with the grades of

Park avenue as now established, and the iron bridges which now carry the railroad tracks over One hundred and twelfth and One hundred and thirteenth streets shall also be removed or be raised to the new grade line.

4. The new viaduct structure of iron or steel, provided for by section two, shall be built at such height that all streets from and inclusive of One hundred and twelfth street to the Harlem River, shall be passed over with a clear height of not less than fourteen feet above the surface of the pavement, and One hundred and fourteenth, One hundred and fifteenth, One hundred and seventeenth, One hundred and eighteenth, One hundred and thirtieth, One hundred and thirty-first, One hundred and thirty-second, One hundred and thirty-third streets, and the exterior street along the bulkhead of the south side of the Harlem River which do not now cross the said railroad shall be opened, regulated, and paved, and shall pass under the new viaduct structure the same as provided for all other streets in this section.

5. The supporting columns of the new viaduct structure shall divide it into spans of about sixty-five feet center to center longitudinally with the railroad and be disposed in groups of three transversely at right angles, one column on the center line of the railroad, and one column on each side of said center line at a distance not to exceed twenty-eight feet each way between the center of said columns, excepting that at the crossings of One hundred and sixteenth and One hundred and twenty-fifth streets, and the exterior street (being one hundred feet in width) columns may be erected on the center line of said streets and also on the curb lines, and the said columns shall not exceed twenty-four inches by twenty-four inches of extreme external diameter above the level of the street pavement, and shall be protected at their bases on the pavement with circular cast-iron wheel guards of sufficient diameter to defend the shafts of said columns from abrasion.

6. The railroad tracks shall be carried on a solid, tight floor, and the drainage water shall be conducted by pipe into the sewers.

7. The New York and Harlem Railroad Company, or its lessee, the New York Central and Hudson River Railroad Company, is hereby authorized and permitted, at its election, to erect station houses on both sides of the railroad at One hundred and twenty-fifth street, with platforms extending from the north line of One hundred and twenty-fourth street to the south line of One hundred and twenty-sixth street; and for the support of the girders to sustain such stations and platforms columns may be erected along the curb lines of Park avenue, between One hundred and twenty-fourth and One hundred and twenty-sixth streets, and on the curb lines of One hundred and twenty-fifth street east and west of Park avenue as may be necessary, the said station columns not to exceed fifteen inches square in size above the surface of the pavement. The said stations and platforms shall be reached by stairs not less than five feet in width, which shall terminate on the sidewalk pavement on both sides of One hundred and twenty-fifth street east and west of Park avenue, and also upon the pavement on both sides of Park avenue adjacent to the north line of One hundred and twenty-fourth street and the south line of One hundred and twenty-sixth street. The station houses may be built over the roadway of One hundred and twenty-fifth street, and may be of a length equal to the distance between the curb lines of the same.

8. The Harlem River shall be crossed by the four tracks of the said railroad on a pivot draw-bridge, the center of which shall coincide with the center of the draw-bridge now standing, but the new bridge shall be so built that the lowest part of its structure shall have a clear height of twenty-four feet above high water of spring tides, and shall provide passageway for vessels on both sides of the center pier, each of one hundred feet width in clear, measured at right angles to the axis or current of the river at the point of its passage under this bridge. The extreme ends of the draw-bridge shall be sustained on abutments of stone masonry, and a protection pier of proper width to effectually protect the structure of the draw-bridge when swung open for the passage of vessels may be built in the river on a line parallel with the direction of the current of the river, no part of which, however, shall in any way diminish the clear width of one hundred feet passageway on both sides of the same.

9. From the north abutment of the Harlem River Bridge the new grade of the railroad shall be carried on a viaduct structure consisting of parallel retaining walls of stone masonry, with earth filling, to the south side of One hundred and thirty-eighth street, with suitable openings for the passage of One hundred and thirty-fifth street and Mott avenue, over which streets the railroad shall pass on bridges of iron or steel, supported on stone abutments. The railroad tracks shall be carried over One hundred and thirty-eighth street on a bridge of iron or steel, of one hundred feet in width, divided into three spans consisting of one clear span over the roadway between the curb lines, and with side spans over each of the sidewalks supported on stone masonry abutments built upon the north and south lines of said street, and by iron columns on the curb lines.

10. In order to secure fourteen feet clear of headroom under the lowest part of the bridge carrying the railroad tracks over One hundred and thirty-eighth street, the grade level of One hundred and thirty-eighth street as now established, shall be altered and be depressed under the said bridge, one and one-half feet, and the bridge which now carries One hundred and forty-fourth street over the depressed tracks of the New York and Harlem Railroad may be raised to a height not exceeding seven and one-half feet above its elevation as now constructed, and the grades of the streets and avenues forming the approaches to the said bridge, that is to say, on One hundred and thirty-eighth street between Mott avenue and Railroad avenue, and on One hundred and forty-fourth street eastwardly and westwardly from the railroad bridge, and on Railroad avenue northwardly and southwardly from One hundred and forty-fourth street, shall be altered and changed to correspond with the depression of One hundred and thirty-eighth street grade, and the raising of One hundred and forty-fourth street bridge, in such manner as may be prescribed by the municipal authorities having jurisdiction in the premises.

11. North of the north abutment of One hundred and thirty-eighth street bridge to One hundred and forty-ninth street the roadbed of the railroad may be raised to its new grade level by filling of earth, or in any other way, at the discretion of the railroad company.

12. The New York and Harlem Railroad Company, or its lessee, the New York Central and Hudson River Railroad Company, during the making of the change in the elevation of the aforesaid structure and bridge is authorized to construct a temporary bridge over the Harlem River, and to maintain such temporary structures as may be found necessary for the operation of its road, and to occupy any part or parts of any public streets or avenues in the city of New York necessary for such purposes, all of which, however, shall be done under the approval, direction and sanction of the board hereinafter appointed.

13. There shall be a board whose duty it shall be to execute, direct, and superintend the construction of the said improvement from One hundred and sixth street to the line of the Harlem River or point at which the new bridge over the Harlem River, authorized by this act to be constructed, shall commence, which board shall be called "The board for the Park avenue improvement above One hundred and sixth street." It shall be the duty of the said board to file a monthly statement under oath of the items of its expenditures with the comptroller of the city of New York. Regular accounts of all its transactions shall be kept by the board, which shall be open to the inspection of the officers of the said railroad company and to the comptroller of the city of New York. The said board is authorized to pass suitable by-laws for its own regulation and government, and to select a presiding officer and secretary from its number. It shall keep a record of all its proceedings. The said board shall consist of five members to be appointed by the mayor of the city of New York, two of whom shall be civil engineers experienced in railroad and bridge construction. In case of the death, removal, or resignation of any member of the said board, or their or either of their successors, the vacancy shall be filled by appointment by the mayor of the city of New York. The said board is hereby authorized and directed to take the entire charge and control of the said improvement from One hundred and sixth street to the line of the Harlem River, or the point at which the new bridge over the Harlem River authorized by this act to be constructed shall commence, and to execute the same in conformity with the provisions of this act, in a substantial and workmanlike manner. Such work shall be done, so far as possible, by contract. Advertisements shall be made as the board shall direct, for bids or proposals for the work proposed from time to time to be contracted, and the contracts shall be awarded to the lowest responsible bidder who shall approved by the board. The contractors shall be required to give such bonds for the faithful performance and execution of the work as the said board shall require. Each member of the board shall receive ten dollars for every day that he shall be employed in the performance of his duties under this act. The board may appoint one of its number as a general superintendent of the work. The said board shall prepare plans of said improvement in conformity with this act, which when approved by the commisioner of public works shall be filed in the office of the comptroller of the city of New York. The said board shall also file with the comptroller specifications and an estimate of the cost of said work. The members of the said board before entering upon the performance of their duties, shall severally take and subscribe an oath or affirmation before a judge of a court of record of the city of New York faithfully to perform the trusts and duties required of them by this act and as a member of the said board. which oath shall be filed in the office of the comptroller of the city of New York. All work to be done upon or under any street, between One hundred and sixth street and the south line of the Harlem River shall be done under the supervision of the department of public works, and the commis-

sioner of public works shall appoint necessary inspectors and engineers for the supervision of such work, who shall be paid a reasonable compensation, to be included in the cost of said improvement.

14. When the said plan, specification, and estimate shall be made and filed as aforesaid, the expense and cost of the said improvement shall be borne and paid by the New York and Harlem Railroad Company, or its lessee, the New York Central and Hudson River Railroad Company, and the mayor, aldermen, and commonalty of the city of New York, in equal proportions, as the construction of the said improvement progresses. When and as often as it shall appear by the certificate of the superintending engineer of the work of the said improvement, duly certified by the aforesaid board, that the sum of twenty-five thousand dollars has been expended thereon by either of said railroad companies, specifying the portions and divisions of the said improvement where the said expenditure has been made, the comptroller of the city of New York shall draw his warrant upon the treasury of the said city in favor of the treasurer of the said railroad company bearing and paying said expense, for one-half of the said sum, which shall be duly signed and countersigned by the proper officers of said city, upon whom by law is devolved the duty of signing and countersigning warrants, and deliver it to the said railroad company for and on account of the one-half of the expense and cost of the said improvement to be borne and paid by the city as aforesaid; but in no event shall the proportion of the cost of said improvement to be paid by the city of New York exceed the sum of seven hundred and fifty thousand dollars, and if the cost of said improvement shall exceed the sum of one million five hundred thousand dollars, then the entire excess over and above such sum shall be borne and paid by the New York and Harlem Railroad Company, or its lessee, the New York Central and Hudson River Railroad Company.

15. For the purpose of raising the sum or amount of the cost of the said improvement to be borne and paid by the city of New York, it shall be the duty of the comptroller and other proper officers of the city of New York to borrow, from time to time, by the issue of bonds, bearing such rates of interest as they may deem proper, not exceeding four per centum per annum, payable semiannually, such sums as may be necessary to pay the one-half part of all amounts called for by the certificates of the superintending engineer provided for in the preceding section of this act. Such bonds shall be known as assessment bonds for the Park avenue improvement above One hundred and sixth street. Such bonds shall be issued by the comptroller, when authorized by the board of estimate and apportionment, at not less than par, for such period as said comptroller may determine, not exceeding five years. Such bonds shall be sold by the comptroller by inviting proposals therefor by public advertisement for not less than ten days, and the same shall be awarded to the highest bidder therefor, and said proposals shall be only publicly opened by the comptroller in the presence of the commissioners of the sinking fund, or such of them as shall attend at the time and place specified in the advertisement therefor. The comptroller, with the approval of said commissioners, shall determine what, if any, of such proposals shall be accepted, and upon the payment into the city treasury of the amounts due by the persons whose bids are accepted respectively, certificates therefor shall be issued to them as authorized by law.

16. Upon the completion of such work and final payment by the comptroller of the proportion of the cost of said improvement to be borne by the city of New York, the mayor, aldermen, and commonalty of the city of New York, by the counsel to the corporation of said city, is hereby authorized and directed to make application to a special term of the supreme court in and for the first department for the appointment of commissioners of assessment, and the said court shall thereupon name three discreet and disinterested persons, being citizens of the city of New York, as such commissioners of assessment, for the purpose of performing the duties hereinafter mentioned in that behalf prescribed. Twenty days' notice of such applications shall be published in the City Record and in at least two other newspapers published in the city of New York. Upon the appointment of said commissioners, they shall severally take and subscribe an oath or affirmation before some officer authorized to administer oaths, faithfully to perform the trusts and duties required of them by this act, which oaths shall be annexed to and filed with their report. In case of the death, resignation, or refusal to act of any such commissioner of assessment, it shall and may be lawful for the court aforesaid, or any one of the justices thereof, on the application of the mayor, aldermen, and commonalty of the city of New York as often as such event shall happen, to appoint a discreet and disinterested person, being a citizen of the city of New York, as such commissioner of assessment in the place and stead of such commissioner so dying, resigning, or refusing to act, and the surviving or acting commissioners, as the case may be, shall have full power to proceed in the execution of their duties under their appointment until a successor of such commissioner so dying, resigning, or refusing to act shall be appointed. It shall be the duty of said commissioners to view the improvement provided for by the terms of

this act from One hundred and sixth street north to the Harlem River, and all such lands, tenements, hereditaments, and premises as they may ultimately include within the area of assessment that may be fixed and determined by them and shall proceed to determine the area upon which an assessment shall be imposed sufficient to meet and pay the entire amount of the assessment bonds which may be issued in pursuance of the provisions of section fifteen of this act, together with interest on such bonds to the date of the levying of such assessment, or such portion of said bonds and interest as the said commissioners of assessment shall determine should be paid by assessment. It shall and may be lawful to and for the said commissioners of assessment, in their discretion, if they deem it equitable and just so to do, but not otherwise, to assess the whole or any part of the said bonds and interest upon the mayor, aldermen, and commonalty of the city of New York. Any area of assessment shall be made so as to include all such lands, tenements, hereditaments, and premises as may by said commissioners be deemed to be benefited by the said improvement, and no others; and having fixed such area and the amount of said bonds, and the interest thereon, to be paid by assessment, it shall be the duty of the said commissioners to make a just and equitable assessment of the benefit to the respective owners, lessees, parties, and persons respectively entitled unto or interested in the lands, tenements, hereditaments, and premises included within the said area or assessment. In each and all and every case and cases where owners or parties interested, or their respective estates and interests are unknown or not fully known to the said commissioners, it shall be sufficient for them to estimate and to set forth and state in their report in general terms the respective sums to be paid, without specifying the names of the estates or interests of such owners, proprietors, or parties interested, or either of them. On the coming in of the said report, signed by said commissioners, or a majority of them, the said supreme court shall, by order, upon the application of the mayor, aldermen, and commonalty of the city of New York, after hearing any matter which may be alleged against the same, either confirm the said report in whole or in part, or refer the same back to the same commissioners for revisal or correction, or to new commissioners to be appointed by the said court to reconsider the subject-matter thereof, and the said commissioners to whom the said report shall be so referred shall return the said report corrected and revised, or a new report to be made by them as aforesaid in the premises, to the said court, without unnecessary delay; and the same, on being so returned, shall be confirmed or again referred back by the said court as justice shall require; and such report, when confirmed by the said court, shall be final and conclusive as well upon the said mayor, aldermen, and commonalty of the city of New York as upon the owners, lessees, persons, or parties interested therein and entitled to the lands, tenements, hereditaments, and premises mentioned in the said report, and also upon all other persons whomsoever.

17. The said commissioners of assessment, at least thirty days before they present their report to the supreme court, shall deposit a true copy or transcript of the same in the office of the comptroller of the city of New York, for the inspection of whomsoever it may concern, and shall give daily notice, by advertisement in the newspapers mentioned in the sixteenth section of this act, for thirty days after depositing such report as aforesaid, of the said deposit thereof in the said office, and of the day on which such report will be presented to the said court; and any person or persons whose rights may be affected thereby and who may object to the same or any part thereof, may, within thirty days after the first publication of such notice, set forth their objections to the same in writing to the said commissioners, who shall, after hearing the parties so objecting, thereupon reconsider their said assessment or part or parts thereof so objected to, and in case the same shall appear to them to require correction, and not otherwise, they shall and may correct the same accordingly. The said commissioners shall include in said report the amount of their fees, and all costs and disbursements for expenses, for surveys, maps, and other things.

18. In each and every case of the appointment of commissioners under this act, it shall be competent and lawful for any two of such commissioners so appointed as aforesaid to proceed and to execute and perform the trusts and duties of their said office, and their acts shall be as valid and effectual as the acts of all the commissioners so to be appointed, if they had acted together, would have been; and further, in all cases, the acts, proceedings, and decisions of a major part of such of the commissioners as shall be acting in the premises shall be as binding, valid, and effectual as if the said commissioners appointed for such purpose had all concurred and joined therein. The commissioners appointed under and by virtue of this act, who shall enter upon the duties of their appointment, shall each be entitled to receive such compensation as shall be awarded by the court upon the confirmation of their respective reports, not exceeding ten dollars for each day they shall respectively be actually employed in the duties of their appointment, besides all reasonable expenses, to be taxed and allowed by said court, for maps, surveys, clerk hire, and all

necessary expenses and disbursements, and the same shall be included in and considered and paid as part of said assessment.

19. The respective sums so as aforesaid assessed by the said commissioners upon the owners and occupants and parties seized or possessed of or interested in the lands, tenements, hereditaments, and premises mentioned in the report of said commissioners, and reported by said commissioners as and for the payment to be made by the parties and persons respectively in the said report mentioned or referred to, and intended as owners and proprietors of or parties interested in lands and premises deemed to be benefited for the benefit and advantage to be derived from the said improvement, shall be a lien or charge on the lands, tenements, hereditaments, and premises in the said report mentioned, or upon the estate and interest of the respective owners, lessees, and parties interested in said lands, tenements, hereditaments, and premises, for or on account of which the said respective sums shall be so assessed by said commissioners upon the respective owners and proprietors thereof, and parties interested therein, as well the said owners and proprietors thereof and parties interested therein, and also the occupants, and each and every of them shall, moreover, be respectively liable to pay on demand the respective sum or sums or assessments mentioned in said report at which the respective lands, tenements, hereditaments, and premises so owned and occupied by him, her, or them, or wherein he, she, or they are interested, or at which the owners or proprietors thereof shall be so assessed, to such person or persons as the comptroller of the city of New York shall appoint to receive the same. The said respective sums or assessments, with lawful interest from the date of the confirmation of the report, may be collected, with all costs and charges by action of the said mayor, aldermen, and commonalty of the city of New York from and against the parties assessed, or the owner or owners of the respective lands, tenements, hereditaments, and premises whereof or in respect of which the same may be assessed or set forth in the said report of the said commissioners, or from or against any or either of the said parties or owners, without joining any other or others of them, the said parties or owners.

20. The moneys collected pursuant to the provisions of sections sixteen, seventeen, eighteen, and nineteen of this act shall be set apart, when collected, as a trust fund, to apply to the redemption of the principal and interest of the bonds for the payment of which assessment shall have been imposed. In the event that the said commissioners of assessment shall have, in pursuance of the provisions of section sixteen of this act, assessed the payment of the whole or any part of said bonds upon the mayor, aldermen, and commonalty of the city of New York, the funds to pay the same shall be raised by tax upon the real and personal property subject to taxation in the city and county of New York, and included in the tax levy for the years in which the said bonds shall fall due. The interest on all of the said bonds shall be paid by the city of New York until the same shall fall due, and the amount thereof shall be raised from year to year by tax upon the real and personal property subject to taxation in the city and county of New York, but any interest that may accrue upon the aforesaid trust fund shall be applied in payment of said interest, and from the time that said trust fund shall be established, the balance of the interest only over and above the amount that may be earned from said trust fund shall be raised by taxation as aforesaid.

21. The new bridge over the Harlem River, authorized to be constructed by the provisions of this act, and the approaches to such bridge authorized to be constructed on the north side of the Harlem River in the Twenty-third ward, shall be constructed at the sole expense of the New York and Harlem River Railroad Company, or its lessee, the New York Central and Hudson River Railroad Company. The said railroad company shall prepare plans and specifications of said bridge and its approaches on the north side in the Twenty-third ward in conformity with this act, and file a copy of such plans and specifications in the office of the comptroller of the city of New York. The said corporation is authorized and empowered to conform the structure of the said bridge to such plans and directions as shall be approved and given by the Secretary of War, pursuant to authority conferred upon him by act of Congress, and except so far as the structure of said bridge shall be subject to the direction of said Secretary of War, the plan therefor and the approaches thereto on the north side in the Twenty-third ward, shall be approved by the board appointed in pursuance of the provisions of this act.

22. All changes in the railroad necessary to conform the grade thereof on the north side in the Twenty-third ward, when elevated as aforesaid, to the new elevation, are hereby authorized and directed, and all grades of the said railroad established by any prior act or acts, or by any contract made by the railroad company owning, or leasing and operating said railroad, or by both, with any public department of the city of New York, or with the city of New York, pursuant to any act of the legislature, are hereby changed to conform to the provisions of this act.

23. All bridges over the New York and Harlem Railroad required to be made by any act or contract pursuant to any act of the legislature of the State of New York which will be interfered with by the change in grade of said railroad required by the provisions of this act, are hereby authorized to be removed except the bridge at One hundred and forty-fourth street, which is authorized to be raised as aforesaid, and the obligation to make and continue the same, as imposed by any act or part of any act, or by any contract made pursuant to any act of the legislature of the State of New York, is hereby removed and annulled, anything in any act of the legislature of the State of New York, or in any contract made pursuant to any act of the said legislature of the State of New York, with any public department of the city of New York, or with the city of New York, to the contrary notwithstanding.

24. The mayor, aldermen, and commonalty of the city of New York is hereby authorized and directed to pass and adopt such ordinances as may be requisite or necessary to facilitate the said improvement. Said improved structure and bridge shall be exclusively for the uses and purposes of the railroad company, and it shall not be lawful for any person or persons, other than a public officer in the execution of his duty as such, with his agents or assistants, to enter or pass upon or through the same or any portion thereof, on foot or in any other way than in the proper cars of such corporation provided for that purpose, without the consent of said corporation, under a penalty of fifty dollars for each offense, to be recovered by said railroad corporation.

25. The cost of the construction of all stations upon said railway, whether provided for in this act or not, shall be borne by the said railroad corporations or either of them, and shall not be included in the estimate to be made by said board of the cost of the proposed improvement from One hundred and sixth street to the Harlem River, or to the point at which the new bridge over the Harlem River authorized by this act to be constructed shall commence.

26. Said board shall begin the improvement and proceed to the completion thereof with reasonable expedition. When completed, the New York and Harlem Railroad Company and its lessee, the New York Central and Hudson River Railroad Company, so long as it remains such lessee, are authorized and directed to run by steam their trains and such trains of other railroad companies as shall have obtained permission therefor voluntarily given by either one of said companies which may be operating said railroad, over the said improvement and the route of the said railroad, and in and upon the depot at Forty-second street, and the switches, turnouts, and sidings, now authorized by law north of said street; and no trains of other companies, without such permission, shall be run thereon.

27. The board appointed pursuant to the provisions of this act shall act upon any and all questions by a majority vote of its members.

28. This act shall take effect immediately.

CHAP. 413.—AN ACT to provide for the construction of a drawbridge over the Harlem River, in the city of New York, and for the removal of present bridge at Third avenue in said city.

[Approved by the governor, May 2, 1892. Passed, three-fifths being present.[

The people of the State of New York, represented in senate and assembly, do enact as follows:

SECTION 1. The commissioner of public works of the city of New York is hereby authorized to erect and construct of stone, iron, or steel, or one or more of these materials, a suitable drawbridge and approaches thereto, with necessary abutments and arches over adjacent streets or avenues, for the passage of all persons, animals, vehicles, and traffic across the Harlem River in said city, connecting the northerly end of Third avenue, in the twelfth ward of said city, with the southerly end of Third avenue, in the twenty-third ward of said city, the said bridge to be constructed as near as possible in the position occupied by the present bridge, which to that end shall be by said commissioner of public works removed so far as may be necessary to allow the construction of the bridge herein provided for, and to make such changes in the grade lines of the streets or avenues approaching the said bridge as may be necessary to carry out the purposes of this act, and for the proper construction of the improvement hereby authorized. Said bridge shall replace the present bridge connecting Third avenue with North Third avenue of said city, and shall, in its width for passage, be not less than sixty feet, and the height of said bridge in the clear, at the draws hereinafter provided for, shall not be less than twenty-four feet above high water of spring tides. There shall be constructed in the said bridge one or more draws, and the length of the bridge occupied by the draw-span or spans and the center pier separating them shall be at least two hundred and forty feet, and said bridge shall otherwise be constructed in conformity with the general provisions of law contained in section six hundred and seventy-six, chapter four hundred and ten, of the laws of eighteen hundred and eighty-two, regulating the construction of bridges over the Harlem River and Spuyten Duyvil Creek. Said bridge shall always be free for the passage of persons, animals, vehicles, and traffic, and when completed shall be kept and maintained in good order and repair by the department of public works in said city: *Provided, however,* That nothing shall be done under this act until the plans and specifications for the said bridge and approaches thereto, with the necessary abutments and arches as aforesaid, as well as the proposed changes hereby authorized in the grade line of the streets or avenues approaching the said bridge, shall have been submitted to and approved by the board of estimate and apportionment of said city.

2. And the said commissioner of public works of the city of New York is hereby authorized to construct and erect of wood or of iron, or both of these materials, a temporary bridge crossing the said river, at or near the point at which the new bridge is to be erected for the purpose of affording passage to pedestrians and vehicles during the time necessary for the removal of the present bridge and the construction and completion of the bridge herein authorized. And the necessary expense of the construction of said temporary bridge shall, after the plans thereof have been submitted and approved of by the board of estimate and apportionment of said city, form a part of and be included within the expenses of constructing the new bridge hereby authorized.

3. The said commissioner of public works shall, upon such approval by the board of estimate and apportionment, proceed to construct the said bridge and approaches thereto, with the necessary abutments and arches as aforesaid, and the same shall be completed within three years from the time of such approval. The work of constructing the said bridge and approaches thereto, with the necessary abutments and arches as aforesaid, and the furnishing of all the material and labor necessary thereof, as well as the work of removing the present bridge over said Harlem River, and the building of the temporary bridge provided for in section two hereof, shall be done by contract made at public letting to the lowest bidder, pursuant to the general provisions of law and ordinance regulating the letting of contracts in said city.

4. The expense of constructing the said bridge and approaches thereto, with the necessary abutments and arches as aforesaid, shall not exceed one million five hundred thousand dollars, and such further sum which may be paid for the lease of land as mentioned in section six thereof, and also such further sum for paying awards and compensation for land taken for the purpose of said bridge and awards for damages caused by reason of the change of grade of streets or avenues approaching the same, authorized by this act, as may be awarded by the board of assessors of the said city, or proper authority, whose duty it shall be to estimate the damage which each owner of land fronting on such street or avenue will sustain by reason of such change to such land or to any improvements thereon, or the value of land taken, and make a just and equitable award of the amount of such damage or value to the owner or owners of such lands or tenements fronting on such street or avenue, and opposite thereto and affected by such change of grade, and the value of any and all lands taken for the purpose aforesaid. The comptroller of said city shall, from time to time, when directed by the board of estimate and apportionment, prepare and issue bonds of said city bearing interest at not more than three per centum per annum and redeemable from time to time, but not less than twenty years after the date thereof, for the purpose of defraying the expense of constructing the said bridge and approaches thereto, with the necessary abutments and arches as aforesaid, and for paying the awards which may be made by reason of any change of grade as aforesaid. Such bonds shall not be sold for less than the par value thereof, and the moneys received from the sale of said bonds shall be deposited in the treasury of the said city, and shall be drawn and paid by the comptroller of the said city for the several objects and purposes provided in this act, upon vouchers in a form to be prescribed by said comptroller.

5. With the consent and approval of the board of estimate and apportionment first had and obtained the commissioner of public works, for and in behalf of the mayor, aldermen, and commonalty of the city of New York, is hereby authorized to acquire title in fee to any land which he may deem necessary for the purpose of the construction of the said bridge and approaches with the necessary abutments or arches aforesaid, and to that end the said commissioner may make application to the supreme court in the first judicial district for the appointment of commissioners of estimate and apportionment, specifying in said application the lands sought to be acquired for the purpose aforesaid. The provisions of law relating to the taking of

private property for public streets or places in the said city are hereby made applicable, as far as may be necessary, to the acquiring of the land as aforesaid. The amount or amounts awarded for the said land and the expense of the proceedings hereby authorized for the acquiring of the same shall not form part of nor be included within the expense of constructing the said bridges, the approaches or the necessary abutments and arches thereto authorized by the fourth section of this act.

6. And if it shall be necessary to obtain land on either or each side of the Harlem River as the termini of the proposed temporary bridge to be erected during the construction of the new bridge hereby authorized, the commissioner of public works is hereby authorized to lease, with the approval of the board of estimate and apportionment of the city of New York, sufficient land on one or both banks of the said Harlem River for said purpose, but said lease shall in no case be executed for a longer period than three years from the time of the approval of the plans and specifications of the new bridge hereby authorized, unless the said board of estimate and apportionment shall thereto consent.

7. This act shall take effect immediately.

E 6.

IMPROVEMENT OF EAST RIVER AND HELL GATE, NEW YORK.

The East River is the name given to the narrow tidal strait which connects New York Harbor with Long Island Sound. It forms an entrance to the harbor of New York secondary in importance only to the main entrance by way of Sandy Hook and the Narrows, since the heavy coasting trade carried on by New York with the New England States and the British American Provinces passes almost exclusively through it.

The population now gathered around the waters of New York Harbor numbers nearly 3,000,000, and should the present rate of increase, as shown by the census returns, be maintained for half a century longer, the population would then be about 8,000,000.

New York city can grow only in one direction, and that is into Westchester County, on the north, since on all other sides it is surrounded by water, and the development of the water fronts along the Hudson and East Rivers must, therefore, be certain and rapid. With the development the importance of the East River entrance to New York Harbor will increase enormously; and it seems not unreasonable to predict that within the next fifty years every foot of shore line on both sides of the East River, within 15 miles of Harlem River and Hell Gate, will be occupied with wharves filled with shipping engaged not only in the coasting and transatlantic trade, but in the commerce of the world.

The East River is crooked and narrow in places, and much obstructed by rocks and affected by violent currents.

The worst of these obstructions is that known as Hell Gate, lying at the mouth of the Harlem River, between Blackwells and Ward islands, about opposite Ninety-sixth street, New York. Here the river turns at right angles around Hallets Point, divides into several channels, and runs with a velocity, varying at different stages of the tide, from 3 to 10 miles an hour over or around Hallets Point, Negro Point, Way Reef, Shell Drake, Pot Rock, Frying Pan, Heel Tap, Holmes Rock, Hog Back, Flood Rock, Hen and Chickens, Gridiron, The Negro Heads, Mill Rocks, Rhinelander Reef, and Bread and Cheese.

On account of the violence and irregularities of the currents and the crowded condition of this passage wrecks at Hell Gate were numerous prior to 1867. At that time some of these rocks projected above the water level, while the least depth over others, at mean low water, varied from nothing to 20 feet. In obedience to the provisions of the act approved June 23, 1866, an examination was made of Hell Gate by the local engineer, with the view of its improvement for purposes of navigation, and three separate projects were submitted January 21, 1867, for the improvement, affording channels of 26 and 24 feet in depth at mean low water. The project which was adopted in 1867 (see Annual Report of the Chief of Engineers for 1868, page 741) provided for the removal of the rocks and reefs that lie directly in the channel to a depth of 26 feet at mean low water, and for the building of sea walls and dikes upon others that lie near the edge of the channel, in order to guide the currents in such a way that vessels might pass the reefs in safety. The cost of the project was estimated at $8,692,645.15. The removal of Hallets Point was begun in 1869 and the final blast occurred September 24, 1876. A new estimate was made January 3, 1870, "based upon the process of tunneling the larger reefs, as Hallets Point and the Middle Reef, and removing the smaller reefs by drilling from the surface of the water," and the cost was placed at $4,689,820.

The steam-drill scow, fitted with a movable dome for submarine work, was first put in operation in the winter of 1870-'71.

The estimate was again revised in 1874 to include the removal of Diamond and Coenties reefs (see Annual Report of the Chief of Engineers for 1874, Part II, page 164), and the total cost fixed at $5,139,120. It provides for the removal *at Hell Gate* to a depth of 26 feet, mean low water, of the reefs at Halletts Point, Way Reef, Shell Drake, Pot Rock, Frying Pan, Heel Tap, Negro Point, and Flood Rock, including the Gridiron, Hen and Chickens, and Negro Heads, and the construction of a dike to connect the Mill Rocks, and sea walls upon Hog Back and Holmes Rock; and, *in other parts of the East River*, for the removal of Diamond Reef and North Brothers Island Reef to a depth of 26 feet, Coenties Reef to a depth of 25½ feet, and the small rocks known as Scaly Rock, Blackwells Rock, and the rock off Wolseys bath house.

The work of mining Flood Rock began in June, 1875.

In 1880 the débris arising from the excavation of the galleries in Flood Rock was deposited partly in a dike to connect Great and Little Mill rocks, and in 1882 a protection wall was built by the city authorities upon the reef at the head of Blackwell's Island known as Bread and Cheese.

The great blast was fired October 10, 1885.

The project was enlarged in 1884 to include the removal of Pilgrim Rock, off Nineteenth street, to 24 feet mean low water, and again in 1889 to include the removal of the reef off Diamond Reef, Ferry Reef, off Thirty-fourth street, and Charlotte Rock, northwest of entrance to Newtown Creek, to 26 feet mean low water; work to be done by hired labor with the drill scow.

At the close of the fiscal year ending June 30, 1891, the following parts of this project had been executed: Hallets Point, covering 3 acres; Ways Reef, Shell Drake, Diamond Reef, North Brothers Island Reef, Coenties Reef, and Scaly Rock had been removed to the depth contemplated in the project; Pilgrim Rock had been reduced to a least depth of 24 feet; Heel Tap had been broken to 26 feet and dredged to 20.5 feet, and the least depths on Frying Pan and Pot Rock were 18 feet and 22.8 feet at mean low water, respectively; Flood Rock and connecting reefs, covering 9 acres, had been broken to 30 feet, and 136,504 tons of the débris had been removed; the Hegro Heads and Hen and Chickens had been reduced to 18 feet mean low water, and a new 18-foot channel, 500 feet wide, opened across the reef, and about one-half of reef off Diamond Reef had been removed to the plane of 26 feet below mean low water.

Hell Gate, as has been said, is the worst obstruction found in the East River; but there are many other rocks and reefs in other parts of this crowded waterway which are constant sources of danger to passing vessels, which have often been complained of and which ought to be removed.

The first to be considered is the long line of reefs and isolated rocks in midstream, extending a mile and a half downward from the foot of Blackwells Island, which have always been troublesome to vessels beating up against the wind or crossing from one channel to the other, as the winds and tides often compel them to do, and which, with the continually increasing size of vessels and the increasing commerce of the river, are becoming still more dangerous. The Man-of-War Rock, marked by a spindle, opposite Thirty-eighth street, and the Thirty-fourth street rock, are prominent parts of this reef.

A second obstruction is the reef lying along the New York shore, between Broome street and Twenty-third street. It is 8,300 feet long and 1,100 feet wide, and prohibits by its numerous shoal points the free use of the wharves on that front by deep-draft vessels. It was surveyed in August and September, 1889, to comply with the river and harbor act of August 11, 1888, and the report thereon was submitted January 24, 1890. The cost of removing the reef to a depth of 18 feet, mean low water, was estimated at $267,996, and to a depth of 26 feet, mean low water, at $4,042,718. Pilgrim Rock, which lies opposite Nineteenth street, and Shell Reef, opposite Tenth street, are prominent projections on this reef.

A third and still more serious obstruction to the navigation of the East River that is constantly complained of by mariners is Middle Ground, which is situated in mid-channel 1½ miles to the eastward of Hell Gate, near the southern entrance to Little Hell Gate, between Sunken Meadows and Lawrence Point, with a channel on either side of barely 350 feet width. A project for lowering this reef to the plane of 18 feet, mean low water, has been approved.

A fourth obstruction, of which complaint has been made, lies in mid-channel between Rikers Island and the continental shore at Baretto Point. It is a rocky ledge whose upper surface is 17 feet below the plane of mean low water. It should be lowered to the plane of 26 feet, mean low water.

The suit begun by private parties to dispossess the United States of its occupancy of the dike built by it between Great and Little Mill Rocks, Hell Gate, was decided by the courts in May, 1889, in favor of the United States, but appeal has been taken by the complainant to a higher court. It is highly important that the United States retain possession of the dike, as the ground is very much needed for wharfage and for repair shops for the steam-drill scow and the dredges. The old machinery and worn-out plant and material stored for many years at Hallets Point have been sold at public auction, and the office for the local conduct of this improvement has been transferred to the dike.

The plant in active use on the improvement has been put in good repair during the year.

The Secretary of War established, March 9, 1892, harbor lines around Great and Little Mill Rocks, Hell Gate, restricting the construction of piers and bulkheads to high-water line.

BRIDGES ACROSS THE EAST RIVER.

(1) The only existing bridge across the East River was built under authority of State act of April 16, 1867, and was later authorized by act of Congress approved March 3, 1869. It is known locally as the "Brooklyn Bridge." The New York terminus is in Park Row and the Brooklyn terminus is in Fulton Street. It is a suspension bridge with a single span across the river, with a height of 135 feet in the clear above mean high water of spring tides at the center of the span and of 118 feet at the piers. The distance between the piers is 1,595 feet. The bridge was opened to traffic May 23, 1883.

(2) Another bridge was authorized to be built across the East River, near the middle of Blackwells Island, by act of Congress approved March 3, 1887. This act required that the construction of the bridge should be begun within three years from the date of approval of the plans by the Secretary of War. As the approval was given in October, 1887, and as the incorporators have not begun work, the authority has lapsed. It is stated that the franchise was reënacted by the State legislature at its last session, but no Congressional act has been passed in relation to it.

(3) By State act approved March 9, 1892, authority was given to the East River Bridge Company to construct and operate a permanent bridge between Broadway, in the city of Brooklyn, across the East River to a point between Delancey and Rivington streets, New York City; also to build a second bridge between Fulton street, in the city of Brooklyn, across the East River, to a point between Jackson and Scammel streets, New York City. These bridges have not yet been authorized by an act of Congress.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

Flood Rock.—U. S. Engineer dredges *Flood Rock* and *Hell Gate* continued at work throughout the year. Dredge *Flood Rock* was engaged continuously on this reef, but dredge *Hell Gate* was transferred to other parts of the East River from March 1 to June 15, 1892.

They have not obstructed the free navigation of the river, as the channels to the northward and to the southward have afforded convenient passage for shipping. It is not advisable, however, to increase the plant at this point, as it is better to defer the final completion of the work than to overcrowd the channels with dredging plant.

The minor repairs necessary to keep the plant in good order were made from time to time without causing any great suspension of work. The winter season was not sufficiently severe to require the withdrawal of the dredges.

The following shows in detail the work done during the year:

Operations.	Dredge Flood Rock.	Dredge Hell Gate.	Total.
Days worked	255	165	420
Hours worked	1,980	1,206	3,186
Surface blasts fired	85	25	110
Dynamite fired .... pounds	6,750	1,250	8,000
Rock removed .... tons	12,920	7,952	20,872
Raised per day .... do	50⅔	48⅕	49⅔

Total removed since explosion, October 10, 1885:

	Tons.
By contract	83,097
By hired labor, using Government plant	94,279
Total	177,376

The dredged rock has been dumped, as heretofore, in the deep hole off Eighty-ninth street, East River. This has not caused any perceptible decrease in depth, the soundings there still ranging from 80 to 120 feet, mean low water.

The result of the year's work has been to reduce practically to 26 feet, mean low water, an area equivalent to one-half of the original reef. The bulkhead, covering an area of about 100 feet by 100 feet, that has been kept intact for the protection of the dredges against the strong currents, has been lowered to 8 feet, approximately, at mean low water, and there is no longer any part of the original obstruction that has over it less than 8 feet at mean low water. No additional width has been gained for the 18-foot channel, which remains, as before reported, at 500 feet.

On September 24, 1890, a special report on this improvement was submitted to the Chief of Engineers, in which the statement is made that for the year ending June 30, 1890, the cost of removing the broken stone by the Government plant was $\$1.08\frac{3}{10}$ per ton, as contrasted with the lowest bid for doing the work by contract in that year of $2.19 per ton. During the year ending June 30, 1891, the cost of raising and dumping the stone by the use of the Government plant was $1.35 per ton, and during the past year the cost was $1.46 per ton, including the cost of repairs to the plant.

This increase of cost for doing the work during the present year over that done shown in 1890 is due to the fact that the stone becomes more difficult to remove as the water deepens. The fine material is sifted from the coarse as the grapple rises through the water, and the lower strata become gradually covered with powdered fragments which obstruct the free penetration of the teeth of the grapple.

Again it is found that portions of the reef are less broken than others, requiring a larger amount of surface blasting to reduce the blocks to the size which it is safe and economical for the grapples to raise.

A survey of the reef is now in progress.

Shell Reef and Middle Ground, opposite Sunken Meadow.—At the opening of the fiscal year, under the contract with R. G. Packard, dated December 19, 1890, operations were in progress on Shell Reef between Eighth and Twelfth streets with a large grapple dredge.

On August 1, 1891, this dredge was transferred to Middle Ground, remaining there until August 19, when she returned to Shell Reef and continued work until September 3, at which time the heavy material lying on the surface had been removed.

On September 10 a large dipper dredge was placed on this improvement, and continued at work until the end of the fiscal year.

During the fiscal year 52,803½ cubic yards of fine material, and 2,507½ tons of bowlders weighing one ton and over were removed.

On April 16, 1892, the contractor applied to have his contract extended, and to have the whole of the unexpended balance of the allotments made for Shell Reef and Middle Ground improvements used at the former place. The application was made on the ground that when the reef was stripped of its thin covering of bowlders and coarse material solid rock only was found underneath for the removal of which the contract contained no provision.

The application was granted by the Chief of Engineers April 20.

The large grapple dredge began work on Middle Ground August 1, and continued until August 18. The area of the reef was stripped of all loose stones, 323 tons of stone weighting one ton and over and 392 cubic yards of small stone being removed. The balance of the reef is solid ledge rock, and will have to be drilled and blasted.

On May 25 the United States Engineer dredge *Hell Gate* anchored on "Nes" rock, on the northern end of Shell Reef, off Nineteenth street. This was a large bowlder which proved too heavy for the dredge to raise, and was broken by surface blast and removed in pieces. Work was then begun on the cluster of bowlders lying on the same reef between Sixteenth street and Eighteenth street. Two large bowlders were blasted and 158 tons were raised, clearing the bottom of all stone projecting above 18 feet, mean low water. On June 15 the dredge retuned to her regular work on Flood Rock.

Ferry Reef, off Thirty-fourth street.—This is a rocky reef in the East River about 1,000 feet from Thirty-fourth street ferry, New York City. It measures 250 feet by 100 feet, and at the time of the survey, in July, 1889, had a least depth over it of 7.1 feet, mean low water. During 1889 this reef was covered by surface blasts by the United States steam drilling scow and the broken rock removed by the United States dredge *Hell Gate;* 1,484 tons of broken stone were raised and dumped, and when work was suspended, November 26, 1889, a depth of 19 feet, approximately, mean low water, had been obtained.

Work was resumed by the United States steam-drill scow *Gen. John Newton* on January 19, 1892, by surface blasting and continued until March 1. A survey made at that time showed that the area of the reef within the 26-foot curve was 13,750 square feet, and an average depth of 22.6 feet, with a least depth of 17.5 feet, mean low water. The quantity of material to be moved to give a depth of 26 feet was 3,600 tons.

On March 3 United States Engineer dredge *Hell Gate* began operations raising the broken stone, and continued until May 9, when she was transferred to Baxter Ledge, Upper New York Harbor.

The United States steam-drill scow having completed the repairs authorized by Department indorsement of January 23, 1892, at a cost of $7,502.45, resumed work on Ferry Reef May 11.

On May 24 the drill scow was transferred to Baxter Ledge to complete the removal of that reef, and returned to Ferry Reef June 17, where work is now in progress.

The following table shows in detail the work done during the fiscal year:

Number of times dome was lowered		4
Number of holes drilled		23
Total depth of holes drilled	feet..	114
Actual time running drills	hours..	23
Number of drill-hole blasts fired		4
Number of surface blasts fired		248
Pounds of explosive used		36,905
Tons of broken stone raised by diver		36
Tons of broken stone raised by dredge *Hell Gate*		1,632
Tons of broken stone and sand raised by pump		95
Total tons raised and dumped during the year		1,763
Total tons raised and dumped since the beginning of operations, September 19, 1889		3,246

Reef off Diamond Reef.—The United States steam-drilling scow *Gen. John Newton* continued work on this reef until January 18, 1892, at which time the final sweep with the horizontal bar was made and no point discovered above the plane of 26 feet, mean low water.

The operations during the year consisted in lowering the high points by surface blasting and in removing broken rock by divers and by the centrifugal pump.

The following table shows in detail the work done during the year:

Number of surface blasts fired	536
Pounds of explosive used (Forcite No. 2)	28,078
Tons of broken stone raised by divers	544.5
Tons of broken stone and sand raised by pump	666.7
Total tons raised and dumped during the year	1,211.2
Total tons raised and dumped since beginning of operations, July 8, 1889	5,691.4

This reef consisted originally of two separate rocky projections above the 26-foot curve, having areas 10,000 square feet and 16,000 square feet respectively, with a least depth of 23.3 feet and 20.8 feet, mean low water. It lies between the Battery and Brooklyn and is about 150 yards northeast of the place occupied by Diamond Reef previous to its removal. The surface of the reef was covered with sand, gravel, and small bowlders, which made the operations of drilling and blasting exceedingly difficult. Work in the swift currents of the East River is necessarily slow, as the divers can not go down excepting at slack water, and, as but two of these occur during the day, each of an average duration of 40 minutes, but little daily progress was possible.

The United States steam drilling scow began work on this reef July 8, 1889, and continued up to January 18, 1892, with but two intermissions, from September 18, 1889, to November 7, 1889, during which time it was placed on Thirty-fourth Street Reef, and from January 27, 1890, to May 13, 1890, during which time operations were suspended on account of cold weather.

Various methods of raising the rock broken by the operations of the drill scow were tried, but the most satisfactory and economical, and the one which was chiefly used, was to drill shallow holes and to repeat the operations of blasting and dredging over the same ground until final depths were reached.

The sand overlying the rock and the small broken stone were pumped up by means of a centrifugal pump. This pump was run only during the time when the currents were too strong for the divers to work under water, and the results obtained were highly satisfactory.

The northwest portion of the reef was swept with the horizontal bar and cleared for a depth of 26 feet, mean low water, on March 23, 1891, and the southeast portion on January 18, 1892. The area swept over was, in the former case, seven times and, in the latter case, four times the area originally developed by the soundings, and the many shoal points found in this area necessitated frequent surface blasting and considerable additional labor.

The following table shows in detail the work done on this reef since the beginning of operations, July 8, 1889.

Number of times dome was lowered	70
Number of holes drilled	563
Total depth of holes drilled ....feet	3,860.2
Actual time running drills ....hours	397.3
Number of drill-hole blasts fired	70
Number of surface blasts fired	1,003
Pounds of explosive used (Forcite No. 2)	71,622
Tons of broken stone raised by divers	1,739.5
Tons of broken stone raised by dredges	2,305.6
Tons of broken stone and sand raised by pump	1,616.3
Total tons raised and dumped	5,691.4
Total number of working days	645
Total number of days worked by dredges	44
Total cost, including hire of dredges	$90,645.92
Cost per ton of rock removed	$15.93

All the old engineer property purchased at various times for East River improvement, and which had been stored at Hallets Point for a number of years, was sold at public auction March 24, 1892, and on the expiration of the lease, May 1, 1892, the engineer office and depot were established upon the Government dike connecting Great and Little Mill Rocks, using for this purpose the Government buildings which had formerly been built upon Hallets Point.

Under authority of the Chief of Engineers, March 2, 1892, the timber wharf on the west side of the dike was enlarged at an expense of $1,074 so as to provide adequate berths for all the Government plant.

The wharf is still somewhat limited for the number of vessels which will use it, but the water space is sheltered and the accommodations afforded will be made to answer present purposes.

The expenses incurred on account of the improvement during the year amounted to $160,546.81, of which $22,895.33 remained outstanding at the close of the fiscal year.

The amount that can be profitably expended in the removal of obstructions in East River and Hell Gate during the fiscal year ending June 30, 1894, is $300,000, to be applied to the removal of Flood Rock, to continuing the operations with the steam drill scow, to extending the work on Shell Reef, and to the removal of such other rocks and reefs at other points in the channel as may be shown to be obstructive to navigation, notably the reefs at Middle Ground and Baretto Point.

As no river and harbor bill for the fiscal year ending June 30, 1893, has passed at the date of this report, it is deemed necessary to say that the balance of $41,673.54 on hand at the close of the year will be reserved to provide for the operation of the drill scow and engineer dredges during the ensuing year. Should such a bill pass before the close of the working season, providing additional appropriation for this improvement, the existing balance will be used in extending work under the contract for the removal of Shell Reef, as authorized by Department letter April 20, 1892, to which reference is made in this report under head of improvement of Shell Reef.

The work is in the collection district of New York. The nearest port of entry is New York City. The nearest light-house is Blackwells Island light. The nearest fort is Fort Columbus, Governors Island, New York Harbor.

AMOUNTS APPROPRIATED.

By acts of Congress approved—	
July 25, 1868	$85,000.00
April 10, 1869	178,300.00
July 11, 1870	250,000.00
March 3, 1871	250,000.00
June 10, 1872	225,000.00
March 3, 1873	225,000.00
June 23, 1874	225,000.00
March 3, 1875	250,000.00
August 14, 1876	250,000.00
June 18, 1878	350,000.00
March 3, 1879	250,000.00
June 14, 1880	200,000.00
March 3, 1881	200,000.00
May 4, 1882	50,000.00
By act of Congress passed August 2, 1882	200,000.00
By acts of Congress approved—	
July 5, 1884	360,000.00
August 5, 1886	112,500.00

By act passed August 11, 1888		$250,000.00
By act approved September 19, 1890		200,000.00
Received from other sources		3,719.62
		4,114,519.62
Deduct amount reverted to United States Treasury	$3,158.55	
Deduct amount allotted to Harlem River	11,000.00	
		14,158.55
		4,100,361.09
Amount expended to June 30, 1892, inclusive of outstanding liabilities		4,057,329.98

Money statement.

July 1, 1891, balance unexpended		$203,577.89
July 30, 1892, amount expended during fiscal year		137,651.48
July 1, 1892, balance unexpended		65,926.41
July 1, 1892, outstanding liabilities	$22,895.33	
July 1, 1892, amount covered by uncompleted contracts	1,357.54	
		24,252.87
July 1, 1892, balance available		41,673.54
Amount appropriated by act approved July 13, 1892		150,000.00
Amount available for fiscal year ending June 30, 1893		191,673.54
Amount (estimated) required for completion of existing project		888,840.67
Amount that can be profitably expended in fiscal year ending June 30, 1894		300,000.00

Submited in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The commercial statistics for the fiscal year ending June 30, 1890, have remained practically unchanged and are therefore herein repeated.

The registered tonnage, exclusive of coastwise vessels and local steamers, so far as it can be ascertained, is 10,165,325 tons.

The commerce of the East River is so intimately connected with that belonging to New York Harbor proper that it is impossible to make a separate statement for it.

The following list of vessels, not inclusive of daily passenger and freight steamers, passing through Hell Gate for the fiscal year ending June 30, 1890, has been compiled from the marine records at Whitestone, Long Island, kept by the New York Herald:

	Bound east.	Bound south.
Steamers	612	1,048
Ships	23	13
Barks	115	56
Brigs	80	61
Schooners	5,498	10,528
Tugs	680	682
Barges	2,612	2,862

CHAP. 101.—AN ACT to incorporate the East River Bridge Company.

[Approved by the governor March 9, 1892. Passed, three-fifths being present.]

The people of the State of New York, represented in Senate and Assembly, do enact as follows:

SECTION 1. George Hoadly, Adolph Ladenburg, Abram J. Hardenberg, George W. Wingate, and Frederick Uhlmann and their associates, or a majority of them, are hereby created a body corporate and politic by the name of the East River Bridge Company, for the purpose and with the duty of constructing and operating a permanent bridge between a point at or near Broadway, in the city of Brooklyn, across the

East River, to a point or place between Delancey and Rivington streets, in the city of New York, hereinafter more particularly described, together with all necessary appurtenances and approaches thereto, and stations, and which is also empowered and authorized to build a second bridge, hereinafter, in section sixteen of this act more particularly described, together with all necessary appurtenances, approaches, and stations; and in all cases of the destruction of either or both bridges, to reconstruct the same; and said corporation shall possess the general powers and privileges granted to, and be subject to the liabilities and restrictions imposed upon, corporations generally by and as prescribed in chapters five hundred and sixty-three and five hundred and sixty-four of the laws of eighteen hundred and ninety, known respectively as the general corporation law and the stock corporation law, and any acts in amendment or in substitution thereof.

2. The capital stock of said corporation shall be twenty-five million dollars, divided into two hundred and fifty thousand shares of one hundred dollars each, and may at any time be increased or diminished by the board of directors with the consent, in writing, of stockholders holding a majority of the stock then issued and outstanding. The shares shall be transferred in such a manner as shall be prescribed by the by-laws of such corporation. Subscriptions to the capital stock of the corporation, except as herein otherwise provided, shall be paid at such times and in such installments as the board of directors may by resolution require. If default shall be made in the payment of any installment as required by such resolution, the board may declare the stock and all previous payments thereon forfeited for the use of the corporation after the expiration of sixty days from the service upon the defaulting stockholder, personally or by mail, directed to him at his post-office address, of a written notice requiring him to make payment within sixty days from the service of the notice, at a place specified therein, and stating that in case of failure to do so, his stock and all previous payments thereon will be forfeited for the use of the corporation.

3. The persons named in the first section of this act, together with four others to be designated by a majority of said persons, shall constitute the first board of directors of said corporation and shall hold their places as such until the first Monday of June, eighteen hundred and ninety-three, and until others shall be elected in their stead. The said persons or majority of them shall meet and organize as such board of directors within thirty days after the passage of this act and adopt by-laws for the corporation. The number of directors after the time last mentioned shall not be less than nine nor more than fifteen, to be fixed by the by-laws of the corporation. An election of directors, all of whom must be stockholders of said corporation, shall take place on the first Monday of May, in the year eighteen hundred and ninety three, and annually on said day thereafter, at an hour and place to be designated by the by-laws; and the persons then elected by a majority of the shares voted upon by the stockholders, in person or by proxy, shall constitute the board for the then ensuing year and until others shall be elected in their places. All vacancies which shall be caused in the board of directors by death, resignation, and mental incompetency, removal from the State or otherwise, shall be filled by appointment by a majority of the remaining members for the balance of the term thus vacated. The board of directors shall have power to make all reasonable by-laws and rules for the government of the corporation and its officers and agents. A majority of said board shall constitute a quorum.

4. The officers of the corporation shall consist of a president, vice-president, secretary, and treasurer, who, except as hereinbefore provided, shall be annually elected by the incoming board of directors; such subordinates may be appointed, from time to time, as the board may direct.

5. The said corporation is hereby empowered to purchase, receive, hold, and use such real estate or interest therein as may be necessary and convenient to accomplish the object for which this charter is granted, and shall have power to locate and construct the necessary approaches to said bridge or bridges, and said corporation may, by its surveyors, engineers, or officers, enter upon such real estate, sites, and locations and take possession of the same, except any public park or parks, none of which shall be taken, except by consent of the local authorities having jurisdiction thereof. All such real estate, sites, or locations, except donations, as shall be entered upon as aforesaid, shall be purchased of the owner or owners at a price to be mutually agreed upon. In case the said corporation can not agree with the owner or owners of any such real estate or of any interest or easement therein, it shall have the right to acquire the same in the manner and by the special proceedings provided for the condemnation of real property by chapter twenty-three, title one, of the Code of Civil Procedure of the State of New York, and any acts amendatory thereof, or in addition thereto.

6. The said corporation is also hereby authorized to lawfully acquire, use, and occupy so much of the land under water or otherwise of the said East River, not exceeding in all a front on either shore of three hundred and fifty feet for any bridge, as may be necessary for the construction of the piers and towers of the bridge to be

constructed by it. If any portion of the land, under water or otherwise, required for the construction of said bridge on or near the shore of either Manhattan Island or Long Island, shall have become or be the property of any individual, or municipal or other corporation, the same may be taken and acquired by the corporation hereby created by proceedings under the condemnation act, as above provided, in cases where said corporation can not agree with the owners thereof for the purchase of the same. But nothing in this act shall be construed to allow said company to take or acquire any lands under water or above water which may have been owned or leased and used as a ferry by any corporation under the laws of the State of New York prior to January first, eighteen hundred and ninety, and which may on that date have been necessarily so used. If any of the sites for the location of the abutments, piers, columns, and anchorages of said bridges or the columns supporting approaches, shall be owned or claimed by the mayor, aldermen, and commonalty of the city of New York, or by the city of Brooklyn, then the commissioners of the sinking fund of the city of New York, if the same be located in that city, or the mayor and comptroller of the city of Brooklyn, if the same be located in that city, are hereby authorized and empowered to agree on behalf of such city, with said corporation hereby created, upon a price or sum to be paid by said corporation for the use and occupancy of said land or lands under water or otherwise, and of the sites; and if such commissioners of the sinking fund of the city of New York or the mayor and comptroller of the city of Brooklyn and the said company are unable to agree upon such price or sum, then said company may take and acquire said land or lands under water or otherwise and said sites by proceedings of condemnation in the manner above provided. But no part of any abutment, column, pier, or anchorage of any portion of any bridge which may be used in whole or in part as a drive or roadway for vehicles drawn by animals, or for use by equestrians, shall be located in whole or in part upon or in any street, avenue, or public place within the city of New York or Brooklyn, except to cross the same: *Provided, however, also,* That any portion of any approach to either of said bridges which may not be used in whole or in part as a drive or roadway for vehicles drawn by animals, or for the use by equestrians, may be supported by iron columns placed in any public street within said cities, or either of them, as designated by the commissioner of public works of either of said cities.

7. The said corporation may borrow such sums of money as may be necessary in the opinion of its board of directors, from time to time, for constructing, completing, and maintaining and operating its bridge or bridges, appurtenances and approaches thereto, and stations, and for acquiring the necessary real estate for the site thereof, the necessary stations, buildings, and appurtenances thereof, and the approaches thereto, and to mortgage its corporate property and franchises, including its franchise to be a corporation, and issue its bonds to secure and provide for the payment of any debt which shall be contracted by such corporation for the purposes aforesaid, upon such terms and conditions as to the board of directors may seem proper, and it shall be lawful for any other corporation to loan its credit to the corporation hereby created, and it shall be lawful for any corporation or any municipality in the State of New York, except where the same may, by the provisions of the constitution of the State of New York, be prohibited from so doing, to subscribe to or become the owner of the stock, bonds, or other securities thereof in like manner, and with like rights as individuals.

8. The said corporation is hereby empowered to merge and consolidate its capital stock, franchises, and property with the capital stock, franchises, and property of any other corporation or corporations, in the manner and with the effect provided in and by the act known as the "railroad law," being chapter five hundred and sixty-five of the laws of eighteen hundred and ninety, and any act or acts amending or extending, or in substitution of the same, so far as the same are applicable thereto, and said corporation shall further have power to lease its bridge or bridges, or any part thereof, its or their appurtenances and approaches thereto, and stations, to any corporation or corporations for such time and on such terms as may be agreed upon, power and authority being hereby likewise conferred on such lessee company to accept such lease or leases. In case of consolidation with any other corporation or corporations, all the powers hereby conferred on said company may be exercised by the consolidated company.

9. The directors of the said corporation may issue stock thereof at such time and in such manner and amounts, and upon such terms as they shall deem proper, and may also issue stock for the purpose of purchasing property, both real and personal, necessary for the purpose of the corporation, to the amount of the value thereof, and may also issue stock for work, labor, and services performed or materials furnished to said corporation for the use and purposes thereof, and the stock so issued shall be deemed full paid and shall not be liable to any further assessments; neither shall the holders thereof be liable for any other payments on such stock, under the provisions of this act, but in all statements and reports of the corporation hereby created to be published, such stock shall not be stated or reported as being paid for

in cash to the corporation, but shall be stated and reported according to the fact. But at least ten per centum of the par value of the capital stock of the company, at the time of the first subscription thereto, shall be paid into the treasury of the corporation in cash, and until such payment shall have been made the company shall have no power to acquire any real estate for its corporate purposes or proceed with construction. Such first subscription shall be made within sixty days after the assent of the proper federal authorities to the construction of its bridge or bridges shall have been obtained, and application for such assent shall be made within one year after the passage of this act.

10. The directors shall have power to fix the rates of toll for persons, animals, carriages, cars, and vehicles, of every kind or description, passing over the said bridge or bridges, and its or their stations, approaches, and appurtenances thereto, and from time to time to change the same as they may deem expedient. Such rates, however, shall not exceed the rates for like services on the existing New York and Brooklyn bridge, as the same prevailed on the first day of January, eighteen hundred and ninety-one, but in the case of service, for which no rate prevailed on that day, the same shall be fixed by the board of directors of the corporation hereby organized.

11. Concurrent jurisdiction shall be possessed and exercised by the courts of the city and county of New York, and the city of Brooklyn and county of Kings, respectively, over all crimes and offenses committed upon any bridge to be constructed by the said corporation.

12. The said corporation and its successors are hereby required to construct, maintain, and operate a bridge, commencing at a point at or near Broadway, in the city of Brooklyn, and between the present pier line and Marcy avenue, in the city of Brooklyn, and said bridge shall be so constructed as to cross the river as directly as possible, to a point between Delancey and Rivington streets in the city of New York; continuing thence westwardly over, through, and across private property between Delancey and Rivington streets and across intervening streets, so that the entrance and exit of said bridge for vehicles, other than cars, and for equestrians, shall be at a point at or near Sheriff street in the city of New York. The construction of said bridge and its roadways and approaches shall be begun within one year from the date of the assent of the proper Federal authorities, and the same shall be completed within eight years after such commencement. The time for the commencement or completion to be extended, however, if any delay shall have been occasioned by legal proceedings, accidents, strikes, or similar emergencies, as much longer as the duration of such delay.

13. An approach to said bridge, so as to provide facilities for its use by the public, shall be constructed and maintained from a point on said bridge at or about Cannon street, in the city of New York, thence extending westwardly over, through, and along private property, and across intervening streets to the Bowery, and thence across the Bowery to Spring street.

14. The approach mentioned in section thirteen of this act may be extended if, in the judgment of a majority of the stockholders of said corporation, it shall be deemed for public convenience so to do, from its termination at the Bowery and Spring street, westwardly, above, through, and along Spring street, to or near the Hudson River, in the city of New York.

15. No part of any bridge hereby authorized to be constructed, or its approaches, shall, except at the termini thereof, be less than sixteen feet above any street, avenue, or public place, or less than fourteen feet above any existing elevated railway in the city of New York, which may be crossed, intervened, or intersected by any bridge or its approaches.

16. The corporation hereby formed and its successors are authorized and empowered to build, construct, maintain, and operate a second bridge, which shall commence at a point between the pier-line of the East River and Fulton street in the city of Brooklyn; the limits of said locality shall be Bridge street on the west and Little street on the east in said city. From the point of beginning said bridge shall extend as nearly northwardly as possible, across private property and across and along intervening and intersecting streets and avenues to the East River; thence across the East River as directly as possible, to a point or place between Jackson and Scammel streets in the city of New York; thence northwestwardly through private property between Jackson and Scammel streets, and across intervening streets to Grand street; thence across Grand street and over private property between Sheriff and Ridge streets and across intervening streets to a point or place on private property between Delancey and Rivington streets, in junction with the line or route of the said bridge hereinbefore first described. The second bridge shall be commenced not later than one year from the date of the opening of the first bridge for public use, and shall be completed within six years after such commencement; the time for the commencement or completion to be extended, however, if any delay shall have been occasioned by legal proceedings, accidents, strikes, or similar emer-

gencies as much longer as the duration of such delay. But no failure to commence the construction of or to complete the said second bridge within the time prescribed shall have any further effect than to prevent the corporation hereby formed, or its successors, from proceeding with the construction or completion of the said second bridge, all other rights, privileges, and franchises hereby conferred to remain unaffected by such failure.

17. Said company shall also have power to construct all necessary approaches other than those hereinbefore specified, and all necessary connections between the said bridge or bridges and approaches, and any railroad or railroads in the cities of New York and Brooklyn, so as to enable passengers to be transferred to and from the same.

18. The bridges to be constructed under the authority of this act and the approaches thereto shall be used for the transit of vehicles for passenger traffic and for pedestrians, for the transportation of freight, and for such other purposes, and in such a manner as shall, in the judgment of the said company, seem most conducive to public interests.

19. Nothing in this act contained shall be construed to authorize nor shall it authorize, the construction of any bridge which shall obstruct the usual and common navigation of the East River, or the construction of any pier in the said river beyond the pier lines established by law. Such bridge shall not be at a less elevation than one hundred and twenty feet at the pier lines, and than one hundred and thirty-five feet at the middle of the East River above high tide at ninety degrees Fahrenheit. From sunset to sunrise suitable signal lights shall be set upon said bridge to guide and direct approaching vessels.

20. The bridge structure or structures to be erected by the corporation hereby formed, its successor or successors, shall be exempt from taxation. And the corporation hereby formed, and its sucessor or successors, shall be exempt from all taxation until ten years after either of said bridges shall have been opened for public use: *Provided, however,* That whenever the average gross earnings of either of said bridges shall have exceeded three thousand dollars per day for six consecutive months, then the corporation hereby created shall be subject to taxation as provided by law, except as to the bridge structure or structures, and said taxation shall be assessed from the first day of said period.

Nothing herein contained shall exempt from taxation any land or lands acquired by said corporation, its successor or successors, for any purposes whatever, nor shall anything herein contained be construed as exempting from taxation at any time the structure of any elevated railroad owned, controlled, managed, or operated by said corporation in the city of Brooklyn or in the city of New York or any other elevated railroad in said cities.

21. The president and secretary of the said corporation shall annually make a verified report to the comptroller or chief fiscal officer of the cities of New York and Brooklyn on or before the first day of November in each year of the gross amount of its receipts for the year ending September thirtieth next preceding, and also a detailed account of its daily earnings during that period, and the books of such corporation shall be open to inspection and examination by each of said comptrollers or officers, or the duly appointed agents of either of them, for the purpose of ascertaining the correctness of its report as to its gross earnings. Whenever such earnings shall, during any period of six months, exceed an average of four thousand dollars per day, then, and in that event, the said company shall thereafter annually, on the first day of December, pay into the treasuries of the respective cities in which any portion of any bridge or bridges, or any approach thereto, or any elevated or other railway which may be owned, controlled, managed, or operated by said company shall be located, to the credit of the sinking funds of the said cities, respectively, a sum equaling in the aggregate one per cent of its gross earnings from the said bridge or bridges, or from any of its approaches, or from any such elevated or other railway or railways, and an additional annual payment of one per cent of such gross earnings shall be made by said company in like manner for each multiple of four thousand dollars per day of such average gross earnings. Such payment shall be in addition to all other taxes to which said company may be subject. The amount thereof shall be annually divided among the treasuries of the cities in each of said cities as the same shall appear by the last completed assessment rolls of each said cities. The corporate rights, privileges, and franchises acquired by such corporation, if it shall fail to comply with all the provisions of this section, shall be forfeited to the people of the State of New York, and upon judgment of forfeiture rendered in an action brought by the people in the name of the attorney-general shall cease and determine. The payments herein provided for shall be made upon the gross earnings of either or both of the bridges herein authorized to be constructed, and upon the gross earnings of any of the approaches thereof, and upon the gross earnings of any elevated or other railway which the said company may at any time acquire, own, manage, control, or operate, whether the same

shall remain in the possession, control, management, or operation of the said company or of any other company or individuals, and shall continue to be so paid in the event of any lease, consolidation, merger, or other disposition thereof. And if the said bridges or either of them, or any of the approaches thereof, or any such elevated or other railway or railways shall be operated in connection with any other railway or railways, the gross earnings for passengers and property shall not, for the purposes of the payment herein provided for, be decreased thereby.

22. This act shall take effect immediately.

E 7.

IMPROVEMENT OF NEWTOWN CREEK, NEW YORK.

Newtown Creek is a tidal stream about 4 miles long, running through the eastern part of Brooklyn, and emptying into the East River opposite Thirty-fourth street, New York. The range of tides is 4½ feet, approximately, but the bed of the creek has no natural slope.

In 1857 it had a depth of about 17 feet, which had decreased in 1880 to about 12½ feet at low water, from its mouth up to the Vernon Avenue Bridge, a distance of 1,100 feet, its width for this distance being about 240 feet. Thence it gradually decreased in width and depth until at the head of navigation, where the Metropolitan Avenue crosses it, there was a low-water depth of about 4 feet and a width of about 100 feet.

A survey of this creek with a view to its improvement was made in 1879 by the engineer officer then in charge, to comply with the act of March 3, 1879, and a report submitted January 31, 1880. The project provided for dredging a channel from the mouth of the creek to Vernon Avenue Bridge, 200 feet wide, and from 21 to 22 feet deep at low water, requiring the removal of 145,000 cubic yards of material, chiefly mud, the cost of which was estimated at $36,250.

Work under this project was begun in 1880, but by reason of increased cost of dredging the estimated cost was increased to $44,050.

Under the act of Congress passed August 2, 1882, another survey was made, and a report submitted December 26, 1883. (Annual Report Chief of Engineers, 1884, page 765.)

The new project provided for carrying the improvement from the Vernon Avenue Bridge up to the head of navigation in both branches of the creek. The estimated cost of executing this project was as follows:

To excavate a channel 18 feet deep and 175 feet wide, from Vernon Avenue Bridge to the Central Oil Works, 145,500 cubic yards excavation, at 30 cents	$43,050
Thence 15 feet deep, and from 125 to 150 feet wide to Queens County Oil Works, 101,600 cubic yards of excavation, at 35 cents per cubic yard	35,560
Thence 12 feet deep, and 125 to 150 feet wide, to Nichols's Chemical Works 52,600 cubic yards excavation, at 40 cents per cubic yard	21,040
Thence 10 feet deep, and from 100 to 125 feet wide to the head of navigation on both branches, 231,600 cubic yards excavation, at 40 cents per cubic yard	92,640
Contingencies	19,229
To which must be added the revised estimate for work below Vernon Avenue Bridge, before given	44,050
Total estimated cost of improving Newtown Creek	255,569

The appropriations of 1884 and 1886 were applied in deepening the channel from the entrance to Vernon Avenue Bridge to 18 feet deep, mean low water, and from Maspeth avenue eastward to the head of navigation 10 feet, mean low water. The amount appropriated up to and inclusive of act of August 5, 1886, was $82,500, of which amount the sum of $50,750 has been applied from Vernon Avenue Bridge to the East River, and $31,750 from Covert Dock upstream to the head of navigation on both branches. These appropriations were made in small amounts and at wide intervals, and the work done by them gave only temporary relief. According to these methods the amounts applicable for improvement at the entrance were about sufficient to remove deposits which had been made during the interval, leaving no balance for increasing the depth beyond 20 feet. The improvement could not, for want of funds, be extended to benefit the central reach of the river above Vernon Avenue Bridge, and, in the absence of secure bulkheads, dredging in the upper branches was of little avail. It would have been better had appropriations been made in such a way that the improvement above Vernon Avenue Bridge could have been executed as an extension of the improvement below it. Then, as the improvement advanced upstream, the wharves along the banks would have been benefited progressively and in proportion to their importance.

A revised estimate for the improvement was made in 1889 (Annual Report Chief of Engineers, 1889, Part 1, page 778), after the results obtained by the survey of January, 1889, had been studied, and the cost was fixed at $170,586.

In preparing the new project for the improvement it was kept in mind that the draft of vessels going above Vernon Avenue Bridge, where the most important wharves are located, was limited by the then available depth of water, and that many of the vessels had to be lightered at the bar to facilitate entrance at high tide, while those going out had to complete their cargoes after they reached the East River. It was therefore thought best to provide for 21 feet from the entrance to Vernon Avenue Bridge, 18 feet to Central Oil Works, 15 feet to Queens County Oil Works, 12 feet to Nichols's Chemical Works, and 10 feet to Metropolitan Avenue Bridge on both branches.

The bed of the creek below Vernon Avenue Bridge is variable in character below the plane of 18 feet, mean low water. Near the bar it is composed of sand or sand and clay mixed; but as the bridge is approached it grows harder, like hardpan, and has large bowlders embedded in it. The creek has a very sluggish current, and where there are no bulkheads the deposits arising from the sewers and from the degradation of the soft and unstable banks cause obstructions to navigation for which annual dredging is the only possible relief.

The appropriation of 1888 was applied in deepening the channel from the entrance to Vernon Avenue Bridge to 21 feet mean low water; to Central Oil Works 18 feet, and to Queens County Oil Works 10 feet.

The river and harbor act of September 19, 1890, appropriated $35,000 for continuing the improvement.

The following table shows the location and characteristics of the several bridges crossing Newtown Creek:

Name and location of bridge.	Width of draw.	Height of bottom chord above mean high water.	Remarks.
	Feet.	*Feet.*	
Vernon Avenue Bridge.	63	7.3	Road bridge; double draw; iron on wooden pier; opens by hand power.
Blissville Bridge (Greenpoint avenue).	58	8.9	Road bridge; double draw; wood on wooden pier; opens by hand power.
Penny Bridge (Meeker avenue).	53	9.7	Road bridge; double draw; iron on stone pier; opens by hand power.
Grand Street Bridge ...	57	5.8	Iron on stone pier; single draw road bridge; opens by hand power.
Metropolitan Avenue Bridge (Metropolitan avenue and Grand street junction).	62	8.7	Road bridge; double draw; iron on stone pier; opens by hand power.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

At the opening of the fiscal year the contract with the Atlantic Dredging Company, dated January 17, 1891 (Annual Report Chief of Engineers, 1891, Part I, page 909), was still in force. Operations under it were in progress on the reach between Central Oil Works and Penny Bridge, which were continued until August 24, when the contract was completed.

The quantity of material removed under this contract during the fiscal year was 15,648 cubic yards, and the total amount removed was 113,452 cubic yards.

At the close of the contract, August, 1891, the channel from the entrance to Vernon Avenue Bridge was 175 feet wide at the entrance, and 150 feet wide near the bridge, and 21 feet deep, mean low water. The channel from Vernon Avenue Bridge to Central Oil Works was 80 feet wide and 18 feet deep; from Central Oil Works to Queens County Oil Works, 50 feet wide and 15 feet deep; from Queens County Oil Works to Penny Bridge, 50 feet wide and 12 feet deep; and the channel from Maspeth avenue to Metropolitan avenue, 100 feet wide and 10 feet deep, mean low water. In the English Kills Branch, which skirts Laurel Hill, the channel was 100 feet wide and 10 feet deep from Nichols's Chemical Works to a point 700 feet to the eastward.

A resurvey of Newtown Creek made in April, 1892, showed that the depths obtained under the contract have not been well maintained. An average shoaling of 2 feet, approximately, has taken place on the inside as well as at the entrance, and this result will be repeated after every improvement by dredging so long as the banks near the head of the creek are allowed to remain without the protection of bulkheads.

A complaint was made to the Secretary of War by the Newtown Creek Towing Company, November 9, 1891, that the bridge across the creek at Meeker avenue was an obstruction to navigation within the meaning of the river and harbor act of September 19, 1890.

The matter was given several public hearings, and on April 20 and May 13, 1892, notices were served, by direction of the Secretary of War, upon the supervisors of Kings and Queens counties, respectively, owning or controlling the bridge, directing that the bridge be altered in such manner as to place the outer faces of the abutments on the legal bulkhead line, and to provide a draw opening on either side of the pivot pier, 65 feet wide in the clear.

The Calvary Cemetery Association was also directed, May 25, 1892, to remove that part of its pier adjacent to the bridge which lies beyond the bulkhead line.

These changes are required to be completed by October 1, 1892.

The amount expended during the fiscal year ending June 30, 1892, inclusive of outstanding liabilities, was $12,554.08.

An appropriation of $100,000 is recommended for continuing the improvement according to the approved project.

This work is in the collection district of New York. Nearest port of entry, New York City. Nearest light-house, Blackwells Island Light, Nearest fort, Fort Columbus.

Amounts appropriated.

Application.	Date.	Amount.
Dredging below Vernon Avenue Bridge	June 14, 1880	$10,000
Do	Aug. 2, 1882	15,000
Part applied above Vernon Avenue Bridge	July 5, 1884	20,000
Below and above Vernon Avenue Bridge	Aug. 5, 1886	37,500
Newtown Creek and Bay	Aug. 11, 1888	25,000
Do	Sept. 19, 1890	35,000
Total		142,500

Amount expended to June 30, 1892, inclusive of outstanding liabilities, $141,448.14.

Money statement.

July 1, 1891, balance unexpended	$13,605.94
July 30, 1892, amount expended during fiscal year	12,554.08
July 1, 1892, balance unexpended	1,051.86
Amount appropriated by act approved July 13, 1892	35,000.00
Amount available for fiscal year ending June 30, 1893	36,051.86
Amount (estimated) required for completion of existing project	78,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	78,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The commercial statistics for the fiscal year ending June 30, 1890, have remained practically unchanged, and are therefore herein repeated.

Imports and exports.

Articles.		Amount.		Value.
		Imported.	Exported.	
Lumber	feet B. M.	263,040,852	21,000,000	$5,936,994
Coal	tons	440,410		1,652,794
Oil	cases		2,937,273	2,900,000
	gallons	19,949,255	29,252,557	3,026,509
Residuum	do	20,093,200	1,378,148	623,438
Grain	bushels	140,000		140,000
Brick		125,000.000		659,000
Lime and cement	barrels	260.000		260,000
Stone and sand	tons	105,000		107,000
Chalk	do	20,000		70.000
Tin, lead, iron, and steel	do	9,776	500	905,791
Oil of vitriol	pounds	20.457,437		135.840
Jute, hemp, manilla, etc	tons	200,000		2,000.000
Empty barrels and cases		577,058	1.036	460.033
Naphtha	gallons		6,464.226	381,983
Candles and wax	pounds		11,765.064	
Separated acid	gallons		1,035,695	19,366
Miscellaneous	tons		24,075	2,236,521
Total				22,045,745

Vessels arriving and departing.

Class.	Number.	Tonnage.
Steamers	12	15,240
Ships	26	31,200
Barks	125	87,500
Brigs	13	10,400
Schooners	22,226	1,113,000
Lighters	1,022	204,400
Barges	2,782	556,400
Canal boats	3,068	306,800
Total	9,274	2,324,940

There were built on Newtown Creek 23 new vessels, 7,200 tons capacity, and valued at $265,000.

E 8.

IMPROVEMENT OF BUTTERMILK CHANNEL, NEW YORK HARBOR.

Buttermilk Channel is the name given to the channel which separates Governors Island, at the mouth of the East River, New York Harbor, from the city of Brooklyn, which lies east of it.

The channel on the northwest side of Governors Island, which separates it from the lower end of the city of New York, is the wider and deeper of the two, and is the channel most used by vessels passing between the East River and other parts of New York Harbor.

Buttermilk Channel was formerly obstructed by three shoals:

(1) A shoal lying above and northeast of Governors Island, projecting into Buttermilk Channel, and extending over to the main channel on the other side, which originally had a least depth over it of 9½ feet at mean low water.

(2) A shoal, putting out from Red Hook Point, on the Brooklyn side, and extending up the eastern side of the channel to the entrance of the Atlantic Basin, with a least depth on it of about 6 feet at mean low water, and an average depth of from 10 feet to 12 feet, mean low water.

(3) A shoal putting out from the southern side of Governors Island and extending towards the Red Hook Point Shoal, which is partly dry at mean water.

Between the first mentioned shoal and Governors Island there was formerly a narrow channel with 30 feet of water in it, and between this shoal and the Brooklyn shore a channel of the same depth, also originally narrow.

A narrow and crooked channel about 30 feet deep lies between the two latter shoals.

The line of docks and wharves from the Brooklyn Bridge down to the mouth of the Atlantic Basin on the Brooklyn side is one of the most important in the New York Harbor, and this part of the river, extending from the Brooklyn Bridge to Governors Island, was formerly regarded by pilots and masters of vessels as one of the most difficult places in New York waters to carry a vessel through safely on account of this shoal, the rapid current, and the enormous traffic passing, not only up and down, but across the stream.

Tows, tugs, small steamers, and small craft generally in passing up and down this part of the East River keep to the New York side, forcing the larger class of sound steamers, ocean steamers, and seagoing ships in tow of tugs to keep over towards the shoal at the upper point of Governors Island, and if, as was often the case, these vessels were obliged to stop in order to avoid collision with ferryboats, sloops, and canal-boat tows, they were liable to drift upon this shoal.

Upon a statement of these difficulties, made by shipping merchants and others whose business lay along the Brooklyn wharves between Wall Street Ferry and the Atlantic Basin, a survey of this shoal was ordered in 1872, and a project for its improvement was adopted in 1880.

The appropriations made by the several river and harbor acts from June 4, 1880, to August 11, 1888, both inclusive, have been applied towards the complete removal of this shoal to a depth of 26 feet, mean low water, at an estimated cost of $346,000.

No work has been done towards the removal of the shoal at the southern entrance to the channel.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

At the opening of the fiscal year a contract was in force with Mr. James A. Simmons, of New York, for the removal of 500,000 cubic yards of material from the shoal. Of this quantity 395,739 cubic yards had been removed prior to June 30, 1891, and an examination made in July, 1891, failed to develop any points above the plane of 26 feet, mean low water.

No further dredging being required on the shoal at the head of Buttermilk Channel, and the contractor not being able to avail himself of the option to remove the balance of the contract quantity from Red Hook Shoal, the contract was closed by authority of the Chief of Engineers, dated July 3, 1891.

The balance available on the completion of this contract was $25,000, approximately. The only place where it could be applied was at Red Hook Shoal, but since that shoal is 2,500 feet long and 1,000 feet wide, with an average depth of less than 10 feet of water at mean low water, and in the vicinity of the buoy marking its western border is composed of compact sand covered with bowlders, the available balance was too small to widen the channel or lower the shoal in a way to benefit navigation appreciably. Besides this, the dredges, which alone could do the work, were already engaged, and it was not possible that they could be secured within a reasonable time, except at excessive rates, not justified by the circumstances.

It was therefore deemed best to hold the money in the Treasury until it could be judiciously used, in connection with the appropriation to be made by the succeeding river and harbor act, towards the removal of the western half of the shoal, in the execution of a project formed for straightening the channel at the southern entrance.

With a large appropriation it is expected that reasonable prices will be obtained, although the material is hard to dredge, and the locality an exposed one with strong currents.

A report was submitted to the Chief of Engineers upon the survey of Red Hook Shoal, in compliance with the river and harbor act of September 19, 1890, in which it is stated that the "shoals opposite the southeast side of Governors Island" (Red Hook Shoal) contain 1,484,043 cubic yards of material, scow measurement, and their removal to the depth of 26 feet, mean low water, was recommended.

The recommendation for the removal of Red Hook Shoal is here repeated; when this work is accomplished Buttermilk Channel, opposite Atlantic Basin, will be 1,000 feet wide, and the set of the currents will be so direct along the southern margin of Governors Island that the improved depths will be maintained with reasonable certainty, without the necessity for an artificial bank to be built upon that island or upon the shoal extending from it to the southwestward.

The amount expended during the fiscal year ending June 30, 1892, inclusive of outstanding liabilities, was $12,051.98.

An appropriation of $200,000 is recommended towards the completion of this improvement, which is required to facilitate the navigation of the southern entrance to Buttermilk Channel, now obstructed by the Red Hook Shoal.

This work is in the collection district of New York. The nearest port of entry is New York City, and the nearest work of defense Fort Columbus, New York Harbor. The nearest light-house is Robbins Reef.

Amounts appropriated.

Application.	Date.	Amount.
Dredging	June 4, 1880	$60,000
Do	Mar. 4, 1881	60,000
Do	Aug. 2, 1882	60,000
Do	July 5, 1884	10,000
Do	Aug. 5, 1886	56,250
Do	Aug. 11 1888	100,000
Total		346,250
Received from other sources		100
Total		346,350

Amount expended to June 30, 1892, inclusive of outstanding liabilities, $321,506.75.

Money statement.

July 1, 1891, balance unexpended	$36,895.23
June 30, 1892, amount expended during fiscal year	12,051.98
July 1, 1892, balance unexpended	24,843.25
Amount appropriated by act approved July 13, 1892	100,000.00
Amount available for fiscal year ending June 30, 1893	124,843.25
Amount that can be profitably expended in fiscal year ending June 30, 1894. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	200,000.00

COMMERCIAL STATISTICS.

The commercial statistics for the fiscal year ending June 30, 1890, have remained practically unchanged, and are therefore herein repeated.

The commerce of Buttermilk Channel is so intimately connected with that of New York Harbor that it is impracticable to determine the amount and value.

The number and tonnage of vessels loading and unloading at the Brooklyn wharves, immediately fronting on Buttermilk Channel, during the fiscal year ending June 30, 1890, as shown by the Maritime Register, is as follows:

Vessels arriving and departing.

Class.	Number.	Tonnage.
Steamers	1,047	1,430,192
Ships	253	389,996
Barks	1,632	783,360
Brigs	312	99,600
Schooners	714	214,200
Total	3,958	2,917,348

This does not include the numerous lighters and canal boats, of which no record is kept.

E 9.

IMPROVEMENT OF GOWANUS BAY,—RED HOOK, GOWANUS CREEK, AND BAY RIDGE CHANNELS,—NEW YORK HARBOR.

Gowanus Bay is a part of New York Harbor lying at the mouth of Gowanus Creek in the southwestern part of the city of Brooklyn. The depth of water in the channel was formerly 7 to 12 feet at mean low water, which was wholly insufficient for the passage of the vessels employed in the commerce of the district. A survey of Gowanus Bay and Creek was made in 1880, and a project for their improvement was submitted in January, 1881.

This project provided for dredging a channel on the north side between the pier lines established by the commissioners appointed by the State of New York in 1875, beginning at the bay and extending up the creek to Hamilton Avenue Bridge 18 feet deep at mean low water, and 200 feet wide, except for the upper few hundred feet near the bridge, where the width was to be gradually reduced from 200 feet to 100 feet.

The total length of the proposed channel was about 9,000 feet, and the total estimated cost of improvement was $182,500.

The proposed channel, however, did not follow the old channel at the mouth of the creek, since the pier line established by the State commission of 1875 crossed the old channel at that point and encroached upon the water grant of the riparian owners.

The owners of this property, Messrs. Beard & Robinson, were anxious, nevertheless, to have the old channel improved instead of having the new one formed, as proposed, outside of the established pier line; but as this could not be done they surrendered their right to build out to the pier line. They signed a paper relinquishing their right to build piers which should obstruct the old channel so long as that channel should be permitted to exist; and the Maritime Association of New York at the same time petitioned that the old channel should be kept open. As the improvement of this channel would, however, help only the land near it on the north side, and not at all that which lay on the opposite or southerly side of the creek, the local officer recommended that the conflict of interests be settled by dredging the natural channel from the Hamilton Avenue Bridge down to the southwest corner of the Erie Basin; and that from that point two channels be dredged—one running northerly along the west side of the Erie Basin to deep water, near Red Hook, and the other running southerly along the wharves on the south side of the bay, towards Bay Ridge.

Both of these channels were to be 200 feet wide and 18 feet deep at mean low water.

This project required for its execution a larger amount of work than the original scheme called for, namely:

The excavation of 583,530 cubic yards of material, which, at 30 cents per cubic yard, would cost	$175,059.00
Contingencies, 10 per cent	17,505.90
Total	192,564.90

In the absence of any special governmental legislation, legal measures conforming to State requirements and necessary for securing the right of way across Beard & Robinson's property, at the mouth of the creek, were completed satisfactorily, after some delay, in May, 1883, and under appropriations of 1881, 1882, and 1883 the proposed Red Hook branch of the channel was dredged 100 feet wide for a length of 2,000 feet, measured from Red Hook, and the southern channel, running towards Bay Ridge, was begun at the southern end, and carried northward for a distance of 1,900 feet to near Forty-third street with depths varying from 21 to 17 feet, except for a few hundred feet at the upper end on the eastern side, where the last cut was left unfinished.

The sum of $7,500 was appropriated by the act of August 5, 1886, and was applied towards the improvement of the Red Hook and Gowanus Creek Channel, which at the close of the contract for dredging, March 12, 1887, was 200 feet wide and 18 feet deep from the entrance to the foot of Court street, Brooklyn, and thence 40 feet wide and 15 feet deep to Sigourney street.

A sketch of the work, June 30, 1885, may be found in the Annual Report Chief of Engineers for that year, Part I, page 672.

Under the estimates of $192,564.90, only $72,500 had been appropriated to June 30, 1887.

In the Annual Report for 1888, page 615, the local officer states that the dimensions previously adopted for the two channels are too small in view of the great increase in length and draft which had taken place lately in the construction of sea-going vessels, especially steamers, and recommended that the depth of these channels should be increased to 21 feet, mean low water, and their width to 400 feet, while to facilitate the handling of vessels in the contracted space near the mouth of Gowanus Creek, and to enable those drawing 21 feet of water to pass directly from the Bay Ridge Channel at Fortieth street to the Red Hook Channel at the southwestern entrance to Erie Basin, without requiring them to go to the junction of the channels at Twenty-eighth street, it was further recommended that the triangular shoal area separating the two channels at the entrance be deepened to 21 feet, mean low water.

It was estimated that these changes would involve the removal of 1,345,000 cubic yards of material, measured in place, as follows:

Red Hook Channel (from entrance to Henry street):		
To deepen it to 21 feet	cubic yards..	70,000
To widen it to 400 feet	do....	100,000
		170,000
Gowanus Creek Channel (from Henry street to Hamilton avenue bridge):		
To deepen it to 21 feet	cubic yards..	350,000
To cut away at the angle	do....	300,000
		650,000

Bay Ridge Channel (from Twenty-eighth street to Sixteenth street, South Brooklyn):	
To deepen it to 21 feet ... cubic yards..	250,000
To widen it to 400 feet ... do....	275,000
	525,000
Total in place ... cubic yards..	1,345,000
Which, at 40 cents per cubic yard, would cost ...	$538,000
Contingencies ...	62,000
Total ...	600 000

The river and harbor act of August 11, 1888, making appropriation for continuing the improvement, reads as follows:

> Continuing the improvement by dredging to 21 feet, mean low water, and widening the channel to 400 feet on the northerly side from the foot of Percival street along the wharves to the 23-foot curve opposite the entrance to Erie Basin, $60,000.

This provided for the commencement of the first and second parts of the project recommended in 1888. The required width of 400 feet at the entrance could not be obtained without dredging inside the pierhead and bulkhead line established by the State in 1875, and the upper 3,000 feet of the creek could not be made 400 feet wide without interfering with the vested rights of property on the west side to such a degree as to practically prohibit the execution of the project. The project, which was accordingly adopted for the application of the appropriation, provided that the channel to be ultimately dredged should be 400 feet wide from the entrance to the eastern end of the Erie Basin, and carried thence 250 feet wide to the foot of Percival street, where provision would be made again for widening the channel by dredging out the three triangular spaces or slips on the north side immediately below that street.

Operations under the contract of February 27, 1889, for the removal of 300,000 cubic yards of material from Red Hook and Gowanus Creek Channel, extending from the entrance near the western entrance to Erie Basin to Percival street, were completed February 26, 1891, and the channel was then 100 feet wide and 21 feet deep, mean low water, from the entrance to Percival street.

The river and harbor act of September 19, 1890, appropriated $60,000 for improving the channel at Gowanus Bay, N. Y., to be applied on the northerly side (Red Hook and Gowanus Creek channels), from the foot of Percival street along the wharves to the 23-foot curve opposite the entrance to the Erie Basin.

The same act appropriated $100,000 for a channel 400 feet wide and 21 feet deep, on the south shore (Bay Ridge Channel), from Twenty-eighth street south along that shore to the 21-foot curve near Bay Ridge.

Harbor lines were established by the Secretary of War March 4, 1890, on both shores of Gowanus Bay.

To remove any misapprehension as to their exact location on the *north shore*, it seems best to state in this place that the pierhead and bulkhead lines so established are coincident throughout from the foot of Ferris street to Hamilton avenue, South Brooklyn. They lie *exterior to the Erie Basin*, and follow to the foot of Court street the exterior sea-wall line established by chapter 398, Laws of the State of New York, 1875; and thence to Hamilton avenue follow the bulkhead line established by chapter 763, Laws of New York, 1857.

In regard to the harbor lines for the *south shore* of Gowanus Bay (along the Bay Ridge Channel), adopted by the Secretary of War March 4, 1890, attention is invited to the fact that "the piers between the adopted pier and bulkhead lines may be filled with solid material when an equal tidal prism is provided in compensation therefor behind the authorized bulkhead lines and adjacent to said piers." (Annual Report Chief of Engineers, 1890, page 815.)

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

(1) General Improvement: Red Hook and Gowanus Creek channels.—At the opening of the fiscal year the contract with W. H. Beard, dated January 8, 1891, for the removal of 260,000 cubic yards of material, was still in force, but no operations were in progress, as the entire plant, consisting of three dredges, was concentrated on the Bay Ridge Channel.

In September, 1891, operations were resumed on the Red Hook Channel with the dredge *Wm. Beard*, and continued until September 30, when the dredge was destroyed by fire, and further work was suspended until after the stormy season had passed.

On March 7, 1892, two dredges were placed on this work, and the removal of the contract quantity was completed on April 30.

The quantity of material removed during the fiscal year was 154,918 cubic yards, and the total amount removed under this contract was 260,032 cubic yards. As the result of this work, the channel from the entrance to Erie Basin to the foot of Twenty-eighth street was made 230 feet wide and 21 feet deep, mean low water, and thence to the foot of Twenty-third street 150 feet wide and 21 feet deep, mean low water.

No improvement beyond Twenty-third street was carried on during the year. The channel in this reach of the creek at the time the last work was suspended, February 26, 1891, was 100 feet wide and 21 feet deep, mean low water, but a survey which was made in May–June, 1892, shows that the present depth does not exceed 18 feet, mean low water.

Since the improvement first began, the natural bed has been lowered about 15 feet, and the deterioration which has been mentioned is due to deposits from Gowanus Canal, to the leveling of the slopes of the improved channel, and to the flow of sand from the wide, unconfined flats lying on the south side below Percival street. Periodical dredging will be required to maintain the improved depths so long as Gowanus Canal, which penetrates South Brooklyn to the east of Hamilton avenue, remains the outlet of local sewers, and tidal currents are allowed to attack freely the unprotected banks of the marginal flats and to transport abraded material into the channel.

	Cubic yards.
The quantity required to be removed to complete the approved project was estimated in 1888 at	1,216,940
The quantity which has been removed under contract since 1888 is	558,439
Quantity remaining to be removed to complete project	658,501

The estimated cost of removal, at 20 cents per cubic yard, is $131,700.

The amount expended on this channel during the fiscal year ending June 30, 1892, inclusive of outstanding liabilities, was $39,081.95.

(2) *Bay Ridge Channel.*—Operations under the contract dated January 8, 1891, for the removal of 450,000 cubic yards of material, were in progress at the opening of the fiscal year, and continued until November 7, when the approach of the stormy season caused a suspension of work.

During the months of July and August three dredges, *Sampson*, *Eric*, and *Wm. Beard*, were engaged on this channel; on September 1 the dredge *Wm. Beard* was transferred to Red Hook Channel, and on October 20 the dredge *Erie* was withdrawn for repairs.

Work was resumed on this channel, May 1, 1892, by the two dredges *Sampson* and *Champion*, and continued until June 18, 1892, at which date the contract was completed.

The quantity of material removed during the fiscal year was 365.025 cubic yards, and the total amount removed under this contract was 449,842 cubic yards. The channel was dredged 120 feet wide and 21 feet deep, mean low water, from Twenty-eighth street south to Thirty-ninth street; thence 90 feet wide and 21 feet deep to Sixtieth street, opposite Bay Ridge.

As the contract has just closed, it is not possible to make positive statements in regard to the future maintenance of this improved channel.

From Twenty-eighth street westward to Thirty-eighth street the natural bed has been lowered 15 feet; from Thirty-eighth street to Forty-first street, 11 feet; and thence to Sixtieth street, 5 feet. These are deep excavations through sand deposits, and, in the absence of bulkheads, satisfactory headway could only be made by passing the dredging plant several times over the same ground, deepening the cut at each successive passage, as well as removing foreign material which during the interval had invaded the channel from the slopes and from the unstable flats.

This accounts for the limited width of 120 feet which is given as the result of the year's work.

It can be readily understood from what has been said in regard to deteriorations that excavations along the line of the projected channel are followed at once by the lowering of the bed of the adjacent flats. This is beneficial to the riparian owner in enabling him to utilize his wharf front at less expense for dredging, but detrimental to the Government in increasing the original estimate of cost for making the channel of the approved width and depth by an amount not capable of computation. Until the riparian owners build confining bulkheads along their fronts the estimates for the ultimate cost of the project will be indefinite.

It would not be unreasonable on the part of the Government to make the continuance of the improvement of this channel contingent upon the construction of these bulkheads.

	Cubic yards.
The quantity required to be removed to complete the project was estimated in 1890 at	993,000
The quantity which has been removed since 1890 is	449,840
Quantity remaining to be removed to complete project	543,160

The estimated cost of removal, at 20 cents per cubic yard, is $108,632.

The quantity required to be removed from the angular shoal area at the junction of the Red Hook and Bay Ridge channels, to give intercommunication between these channels at Fortieth street, is estimated at 641,000 cubic yards. The cost of its removal, at 20 cents per cubic yard, is $128,200.

The amount expended upon this channel during the fiscal year ending June 30, 1892, inclusive of outstanding liabilities, was $95,833.35.

In the foregoing remarks upon the two channels in Gowanus Bay undergoing improvement attention has been called to local sources of deterioration in each case. Another influence, to which no allusion has been made, operates at the entrance to deteriorate both channels alike. The bay, one-half mile wide at the entrance, is open to storms from the north round to the southwest, and is constantly threatened by deposits of material brought in by waves and currents, which sweep over the long outlying shoal covering the entrance from Red Hook Point to Bay Ridge. Though this shoal certainly supplies material to degrade the inshore channels, yet its removal has not been considered expedient.

The river and harbor act of September 19, 1890, made provision for a survey of Bay Ridge Channel, with a view of removing this shoal, and a report in compliance therewith was submitted to the Chief of Engineers, October 17, 1890 (Annual Report Chief of Engineers, 1891, Part I, page 918), in which it is stated that the shoal between the 23-foot curves, mean low water, contains 10,000,000 cubic yards, scow measurement, of material. The cost of its removal, at 20 cents per cubic yard, is $2,000,000.

The removal of the shoal was not recommended, however, for the reason that the wharves on the south shore of Gowanus Bay would become in that event more exposed than at present to high seas coming from the westward and northwestward, and shipping would eventually have to be protected, at great cost, by an artificial breakwater located somewhere along the line of the existing shoal.

The Harbor-Line Board had in mind the exposure of this shore when recommending to the Secretary of War that authority be given, under certain stated conditions, for the construction there of solid piers between the pierhead and bulkhead lines.

All things considered, it seems the better policy, therefore, to retain the outlying shoal undisturbed for the present, and to remove by annual dredging from the inner channels the deposits which may be caused by waves and currents acting upon the shoal, and by the sliding of the marginal flats.

A chart showing the condition of the two improved channels in Gowanus Bay at the close of the fiscal year accompanies this report.

The amount that can be profitably expended upon the improvement of Gowanus Bay channels during the fiscal year ending June 30, 1894, is $250,000, which amount should be appropriated in one sum for distribution, by allotment, between the Red Hook and Gowanus Creek and Bay Ridge channels, and the triangular area between them at their junction, at the discretion of the Secretary of War.

Gowanus Bay is in the collection district of New York City. Nearest light, Robbins Reef. Nearest work of defense, the fort on Governors Island, 1 mile to the northward.

Amounts appropriated.

Application.	Date.	Amount.
Dredging	Mar. 3, 1881	$40,000
Do	Aug. 2, 1882	20,000
Do	July 5, 1884	5,000
Do	Aug. 5, 1886	7,500
Do	Aug. 11, 1888	60,000
Do	Sept. 19, 1890	160,000
Total		292,500

Amount expended to June 30, 1892, inclusive of outstanding liabilities, $291,357.20.

Money statement.

July 1, 1891, balance unexpended	$136, 058. 10
June 30, 1892, amount expended during fiscal year	106, 878. 53
July 1, 1892, balance unexpended	29, 179. 57
July 1, 1892, outstanding liabilities	28, 036. 77
July 1, 1892, balance available	1, 142. 80
Amount appropriated by act approved July 13, 1892	198, 600. 00
Amount available for fiscal year ending June 30, 1893	199, 742. 80
Amount (estimated) required for completion of existing project	281, 400. 00
Amount that can be profitably expended in fiscal year ending June 30, 1894	250, 000. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The commercial statistics for the fiscal year ending June 30, 1890, have remained practically unchanged, and are therefore herein repeated.

[For the year ending December 31, 1889.]

Receipts and shipments.

Articles.	Quantity.	Value.
Coal ... tons..	687, 000	$2, 748, 000
Brick ... number..	202, 000, 000	1, 414, 000
Lumber ... feet, B. M..	147, 000, 000	2, 940, 000
Lime, etc ... barrels..	460, 000	690, 000
Grain ... bushels..	2, 750, 000	1, 100, 000
Ice ... tons..	230, 000	805, 000
Roofing tar ... barrels..	75, 000	225, 000
Building stone, etc		647, 000
Miscellaneous		2, 500, 000
Total		13, 069, 000

Vessels arriving and departing below Hamilton Avenue Bridge.

Class.	Number.	Tonnage.
Steamers	46	83, 211
Ships	68	105, 741
Barks	489	441, 614
Brigs	56	17, 627
Schooners	281	57, 392
Total	890	655, 585

Vessels arriving and departing above Hamilton Avenue Bridge (record of bridge tender).

	Times opened and closed.	Vessels passed through.	Registered tonnage.	Daily average of times opened.
June 1, 1889, to May 31, 1890	8, 624	7, 668	1, 430, 664	28
1888	7, 632	6, 071	985, 431	21
Increase	992	1, 597	445, 233	7

Classification of vessels.

	Number.	Registered tonnage.	Draft.
			Feet.
Schooners	1,393	172,738	6–12
Sloops	972	62,925	6–10
Barges	1,625	409,486	6– 8
Canal boats	3,678	785,515	6– 8
Total	7,668	1,430,664	....

The increase in value of receipts and shipments compared with 1887 is $749,000. It is believed that the values as stated in 1887 are too large, and that the true increase is very much larger.

BAY RIDGE CHANNEL.

These statistics have been compiled this year and are not included in the previous table:

Material.	Value.
Asbestos, cement, paint, and roofing	$2,225,000
Brick and lumber	350,000
Export sugar, machinery and castings	175,000
Petroleum and its products	3,300,000
Phosphates	350,000
Ship and yacht building, dry docks, machine and boiler works, and other industries	1,000,000
Total	7,400,000

There are large factories and piers building along the line of the channel, which will enhance the tonnage and values.

Of larger vessels, such as ships, barks, etc., about 300 have been at the docks. From observation, it is estimated that there are about 1,200 of smaller craft.

E 10.

IMPROVEMENT OF NEW YORK HARBOR, NEW YORK.

New York Harbor is the name applied to the waters surrounding the city of New York, comprising parts of the Hudson, East, and Harlem rivers, and the upper and lower bays lying respectively inside and outside of the Narrows, and between the Long Island, Staten Island, and New Jersey shore.

The city of New York, from which the harbor takes its name, lies at the mouth of the Hudson River at its junction with the East River; and with the adjacent cities of Brooklyn and Jersey City, which are but the natural outgrowths of New York energy and enterprise, includes a population of nearly 3,000,000 inhabitants, which is more than the population of any State in the Union, excepting New York, Pennsylvania, Ohio, Illinois, and Missouri.

At this port two-thirds of the merchandise imported into the United States is received, and two-thirds of the import duties are collected. From this port are sent one-half of the domestic products of the country which are exported, and here one-half of the foreign tonnage trading with the United States enters. Three-fourths of the passengers-traveling between the United States and foreign countries come and go by the way of New York, and three-fifths of all immigrants land at this port.

New York Harbor has two entrances—one by the East River and Hell Gate, leading into Long Island Sound, used chiefly by vessels trading between New York, the Eastern States, and the British American provinces; the other, which is the main entrance, leading out through the Narrows, by Sandy Hook, directly into the Atlantic Ocean, and used by all the transatlantic steamers and vessels.

The Hell Gate entrance has been in course of improvement since 1869, and with its successful completion—which is now assured within a few years—and with the steady growth of the city towards the north, it must come, more than ever, into use by foreign-bound vessels.

The main or Sandy Hook entrance into New York Harbor is one of the best in the world. The channel prior to 1884 was less than 24 feet deep at mean low water and nearly 29 feet at mean high water, with abundant breadth, and was ample for all the commercial requirements of the port, until the great increase in the length, tonnage, and draft of the transatlantic passenger steamers made further deepening necessary in order to prevent the delays to which they were subjected by having to wait for high water in order to pass either in or out.

Before the improvement of the Main Ship Channel into New York Harbor was undertaken by the United States, it was obstructed by four shoals, as follows:

1. The outer bar, about 4,000 feet wide, the channel across which is known as Gedney Channel, where there were depths of 23.7 feet in mid-channel, and 22.3 feet in the southern half.

2. The shoal at the mouth of the Swash Channel, about 4,000 feet wide, where the depth was 24.3 feet.

The channel across this shoal has been named the Bayside Channel.

3. The shoal northwest of Sandy Hook, about 2,000 feet wide, on which the least depth was 26.2 feet.

4. The shoal in the Main Ship Channel in the lower bay, west of Flynn Knoll, nearly 3 miles long, on the crest of which the depth was only 23.9 feet in mid-channel, with depths of 22.6 feet within a few hundred feet of the mid-channel range.

A large proportion of the vast commerce of the port, which was carried on in vessels of great draft, could only cross these shoals at, or near, high water.

The reasonable demand which had been made in 1884 by commercial bodies residing in New York City that increased facilities should be afforded for entering the port of New York by the Sandy Hook route was recognized in the river and harbor act of July 5, 1884, which provided for "deepening Gedney Channel through Sandy Hook Bar, New York, $200,000."

A few words upon the subject of the lower harbor and of the various channels across the bar at the entrance are here necessary for a proper understanding of the causes which led to the adoption of the Main Ship Channel for improvement.

Gedney Channel is the main channel across the Ocean Bar, lying at the entrance to New York Harbor, about 3 miles outside of Sandy Hook and east by north of it. Sandy Hook lies about 9 miles outside of and nearly south from the Narrows, which is the name given to the strait separating the nearest points of Long Island and Staten Island, and the Narrows, in turn, are about 7 miles south from the Battery at the extreme southern end of Manhattan Island, upon which New York is situated. The Narrows are about 1 mile wide. That part of New York Harbor lying outside of the Narrows is commonly known as the Lower Bay.

From the Narrows northward to New York City there is no water less than 6 fathoms (36 feet) deep in the main channel.

Lower bay is a large tidal basin, with an area of about 100 square miles, estimating inside or northward and westward of a line drawn from Sandy Hook to Coney Island.

The western end of the bay formed by Sandy Hook, the adjacent Jersey shore, and Staten Island, is known as Raritan Bay, and the southern part of it inside the peninsula of Sandy Hook is known as Sandy Hook Bay, or more commonly as the Horseshoe.

From the northwest around by the east to south-southeast the Lower Bay is open to the full sweep of the Atlantic Ocean.

From the Narrows to the northern point of Sandy Hook is about 9 miles; but the shortest distance across the bay, from the point of Sandy Hook to Coney Island, is 7 miles. The water cross section on this line at mean low water is about 790,000 square feet, through which the mean velocity is, approximately, 1.6 feet per second; but the maximum velocities are approximately twice as great (Board of Engineers' Report for 1884).

At the Narrows the channel is about 1 mile wide and 70 feet deep, with depths in it of over 100 feet.

Below the Narrows there is one main channel, commonly known as the Main Ship Channel, running southward to a point about 1 mile west of the upper end of Sandy Hook; thence turning at right angles northward and eastward for 4 miles to the head of Gedney Channel; and thence through Gedney Channel east to the deep waters of the ocean.

But along and inside the above-mentioned cross section of 7 miles between Sandy Hook and Coney Island there is a wide shoal with five distinct channels of varying depths running through it seaward and eastward.

They lie in the following order, beginning at the northward:

(*1*) *The Coney Island Channel.*—In which the navigable depth at mean low water is 10 feet.

(*2*) *The Fourteen-Foot Channel.*—In which the navigable depth at mean low water is 15 feet.

(*3*) *The East Channel.*—In which the navigable depth of water is 19 feet.

(*4*) *The Swash Channel.*—Through which 22 feet can be carried at mean low water in a narrow channel.

(*5*) *The Main Ship Channel.*—In which, prior to 1885, 24 feet only could be carried through different reaches with lumps in them, over which the depth was only 23.3 feet at mean low water. The northern reach, which passes along the west side of Flynn Knoll, is maintained by tidal flow through the Narrows; and the southern reach, along Sandy Hook, is maintained by tidal flow through Raritan Bay.

These five channels are separated by shoals with from 4 to 18 feet of water over them at mean low water.

The first three of these channels head directly out into the open sea; but the two latter converge into an area of about 2 miles square, lying north and east of Sandy Hook, which has a depth in it of 30 feet of water, and over, and from this deep area two channels lead eastward into the open sea over the outer bar, the northernmost known as Gedney, the southernmost as the South Channel, both of which had, prior to 1885, only 24 feet of water in them at low water. Gedney Channel, the wider, was originally the deeper and straighter of the two and was therefore used by all the large vessels.

The Swash Channel is really a cut-off from the Main Ship Channel, leaving it about 6 miles below the Narrows, and joining it again at the western end of Gedney Channel.

Apart from being shoaler, the Swash is much narrower than the Main Ship Channel.

The distance from the Battery, at New York, to 30-foot soundings outside the bar in Gedneys Channel, is 22 miles; and by the Swash it is 18 miles, or from the Narrows 15 and 11 miles, respectively.

As the appropriation of 1884 was made in advance of an approved project, the local officer was authorized and directed to make a survey of the Lower Harbor from the eastern end of Coney Island to Sandy Hook with the view of determining the most feasible plan of improvement. The survey was completed in November, 1884, and a report recommending the eventual improvement of the Main Ship Channel, accompanied with estimates of cost and chart, was submitted December 6, 1884. (Annual Report, Chief of Engineers, 1885, page 773.)

The navigation of the Main Ship Channel, inside the bar, especially on the approach to the Narrows from the Southwest Spit, is so intimately connected with that of Gedney Channel across the bar that it was deemed important, in submitting an estimate of cost for the improvement of the latter channel directed to be made by Congress in the act of 1884, to extend the estimate to include the entire Main Ship Channel at Flynn Knoll, and to recommend that the improvements at the several intermediate shoals should take place simultaneously. The project providing for deepening the channel across the bar to 28 feet by dredging and for the contingent construction of a stone dike on the north side of the harbor which had been recommended by a Board of Engineers December 24, 1884, received the approval of the Secretary of War December 27, 1884 (Annual Report Chief of Engineers, 1885, Part I, page 774).

The project under which the improvement began provided for improving the western end of Gedney Channel for a length of 4,000 feet, measured along its axis, and the Main Ship Channel, west of Flynn Knoll, from Buoy No. 10, at the western end of the Southwest Spit, north to Buoy No. 12, then situated 1½ miles south of the western entrance to Swash Channel, the depth to be 30 feet mean low water.

The cost was estimated at $970,000, not inclusive of any allowance for irregularities of cutting, or for increase of bulk for scow measurements. After the work had progressed for one year, and these allowances could be estimated with some degree of accuracy, the estimate was revised, and the cost of executing the project as then approved was fixed at $1,370,000.

The river and harbor act of August 5, 1886, containing provisions for continuing the improvement at the entrance to New York Harbor, read as follows:

> Improving New York Harbor, New York: To secure a 30-foot channel at mean low water at Sandy Hook entrance of the harbor, upon such a plan as the Secretary of War may approve, $750,000.

By the specific wording of this act Congress gave an express approval of an improvement which contemplated a navigable channel 1,000 feet wide and 30 feet deep, mean low water, through the Main Ship Channel and Gedney Channel, and all subsequent acts have confirmed the provisions of the act of 1886.

In 1887 the project was enlarged so as to embrace a length of 4,500 feet in Gedney Channel, measured along the axis, or a length of 6,000 feet, measured along the north side; to remove the shoal in the Main Ship Channel at the southern entrance to the Swash Channel, afterwards called the "Bayside Channel"; to remove the shoal northwest of Sandy Hook; and to extend the Main Ship Channel north from Buoy No. 12 to and beyond the northern entrance to the East Channel, at Buoy No. 14 (now Buoy No. 10). The total estimated cost of the project so enlarged, based on the existing prices for dredging, was $1,490,000.

The river and harbor act of August 11, 1888, appropriated $380,000 for continuing the improvement.

The river and harbor act of September 19, 1890, appropriated $160,000 for continuing the improvement, making the total amount appropriated at that date $1,490,000, the total estimated cost of the improvement.

The first operations began September 26, 1885, and the plant which has been used for the execution of the improvement has consisted solely of centrifugal pumps, and the excavations have been deposited beyond the bar in the vicinity of the Scotland light-vessel.

The quantity which has been removed from the several reaches of the Main Ship Channel, extending from the head of the East Channel to deep water beyond the bar through Gedney Channel, from September 26, 1885, to June 30, 1892, may be classified as follows:

	Cubic yards.
From Gedney Channel	1,161,244
From Bayside Channel	448,313
From Northwest Shoal	118,758
From west of Flynn Knoll	3,146,764
Total quantity excavated	4,875,079

The protection of the eastern and northern shores of Sandy Hook, composed of irregular sand dunes, against wave and current action forms part of the project for improvement of the Main Ship Channel through the lower harbor, but as the work required to be done there was necessarily tentative, it was deemed best to limit expenditures to small sums of money annually while studying the most economical plan of improvement.

Sandy Hook, like the more southerly part of the coast of New Jersey, where the foreshore is a long submerged shoal, has had a varied experience in changes of form and extent resulting from tidal and current action, supplemented by wave action during storms.

The eastern shore along False Hook Channel is a long, unbroken beach, remarkably uniform in its contours, and, as it is under the cover of the outlying shoals, has undergone few changes either of accumulalation or degradation.

From the northeast corner of the Spit, where the outer shoal has diminished width, westward around the Hook to beyond the Hook Beacon, the north shore is open to northerly and easterly storms, and is particularly subject to frequent changes, and it is on this front that the shore protections have been laid.

The great ravages made there by the sea in 1863 made shore protection an immediate necessity, and during the next twenty years many points were protected along the crown of the Hook from east to west, the improvements taking the form of jetties extending out, at varying angles with the shore line from near high-water to below low-water mark.

The Main Ship Channel hugs this shore, and the water at a distance of less than 2,000 feet has a depth of over 60 feet. The slope of the foreshore is precipitous, and as the main object of the improvement was to preserve the high-water line and the dunes behind it, there being no marked tendency of the currents to cut below the low-water line, it was thought best to place the outer ends of the jetties near the latter curve. To have anchored the jetties in deep water, under the circumstances, would have been unjustifiably expensive.

Some of the jetties were built of timber, some of timber, brush, and broken stone, and others of concrete, either in bags or in forms. In 1883–'84 the timber jetties, which were in a state of decay, were wholly replaced by concrete, built in place and arranged in sections 10 feet long, so that when undermined, either at the end or on the sides, it would settle by sections without fracturing the body of the jetty.

The cement used was a brand of American Portland. The general cross-section area of the jetties was 50 square feet. While these jetties served to cover a certain part of the shore line for certain winds, it was noticed that they gave no protection to the high-water line during storms from any direction coincident with spring tides. In the latter case, no matter what the direction of the wind, the cliffs, at some point above the high-water mark, were attacked and degraded by the waves.

To prevent the complete destruction of the cliffs, and to arrest the recession of the high-water line before the foundations of the defenses and other public buildings were reached, it was decided in 1890 to run a riprap wall just below the high-water line completely around the Hook uniting all the jetties.

The work, which was begun in May, 1890, was continued to completion in September, 1891. The wall is 2,575 feet long, extending from Jetty No. 1 to about 119 feet westward of Jetty No. 11, and had a cross section when first laid of 50 to 60 square feet.

The stones vary in weight from 300 pounds to 3 tons, and are laid directly upon the beach, with the purpose that each stone shall arrange its bed at once after the sea attack, allowing a gradual settlement of the wall without sudden dislodgment of the stone. The cost was $6 per running foot of wall.

During the past two years the whole wall has settled gradually, with very little lateral displacement of stone, but it has perfectly shielded the cliffs during the northerly and easterly storms, while the jetties have caused the beach pockets to fill up during the intervals of southerly seas, causing the low-water line to move outwards.

The amount expended upon this protection since 1890 aggregates $19,095, and the cost, including repairs for settlement, was $7.41 per running foot of wall.

At the close of the year the Hook is in a satisfactory state of preservation.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

At the beginning of the fiscal year there was in force the contract with the Joseph Edwards Dredging Company, dated February 16, 1891, for the removal of 500,000 cubic yards of material from the main ship channel. Operations were in progress with the hydraulic suction dredges *Reliance* and *Mount Waldo*, and continued uninterruptedly until October 10, 1891, at which date the contract was completed.

The quantity of material removed during the fiscal year was 213,268 cubic yards, and the total amount removed under this contract was 500,053 cubic yards.

The work under this contract was done on the west side of the Main Ship Channel, from Buoy No. 12 (Southwest Spit) northward to deep water below the Narrows.

The close of this contract completed the approved project for this work, by dredging, as at that time a depth of 30 feet, mean low water, for a channel width of 1,000 feet, had been secured from deep water below the Narrows to deep water beyond the bar.

Surveys of all the improved channels were made during November and December, 1891, and January, 1892, and the results showed that the improved depths have been maintained without deterioration.

The successful completion of this improvement should be a matter of great gratification to the contractors as well as to the engineers. When work was begun, in September, 1885, the navigable depth in the channel was 22½ feet only, and the width barely 600 feet, while now, as before stated, the depth is 30 feet and the width 1,000 feet. The quantity of material estimated in 1887 to be removed to complete the entire project was 4,947,315 cubic yards; the total quantity removed since beginning of improvement was 4,875,079 cubic yards; the estimated quantity, therefore, exceeded by 72,236 cubic yards the quantity actually removed.

The criticism has been made by persons who are ignorant of the physics of the harbor, or have not studied them closely, that a better improvement could have been made by deepening and extending the East Channel. The answer to the criticism is an easy one. If the configuration of the shore of the lower bay and the channels of deepest water through the shoals be examined attentively, it will be observed that the tidal prism of the harbor exhausts itself chiefly through Raritan Bay, and that the direction of the most prolonged flow of the ebb currents is along the northern shore of Sandy Hook, and that in consequence the deepest water must be found there. The channels to the northward are fed by the ebb tides, which flow principally from the Narrows, and the quantity of water which passes through there to maintain improved depths is so small in comparison with what passes through the more southerly channel as to condemn at once those channels for improvement. The gratifying manner in which the improved channel has been maintained along a distance covering nearly 12 miles for the past seven years, is further confirmation of the wisdom of the selection of the more southerly channel for improvement.

While there is no evidence of any appreciable decline in the Main Ship Channel, provision should be made for unforeseen shoalings which are liable to occur, especially on the outer bar, which, if disregarded, would interfere seriously with the commerce of the port which passes over the bar at the southern entrance.

It would therefore be wise to provide for the purchase or construction of a vessel fitted with bins and with suction pumps similarly arranged to those which were used in effecting the improvement. The vessel should be operated by hired labor, and kept constantly in commission, ready to work at any part of the improved channel whenever its services may be required. In this way the channels may be kept open at the smallest cost and with least detentions to commerce.

An appropriation of $250,000 is recommended for the purchase or construction of such a vessel, and to provide means for running expenses for two years.

BAXTER LEDGE.

Baxter Ledge is a narrow ledge of rock lying in the entrance to Kill van Kull from Upper New York Bay, northeast from St. George, Staten Island, the wharf terminus of the Staten Island Rapid Transit Railroad Company.

This reef was struck by a vessel about three years ago, and an examination made at that time by the light-house department showed that the least depth over it was 18 feet, mean low water, and it was subsequently marked by a danger buoy. The ledge was a menace to deep-laden vessels navigating the Kills, and the buoy itself formed a dangerous obstruction to the Staten Island ferryboats, as it lay directly in their path.

The removal of this reef was authorized by the Chief of Engineers March 15, 1892. United States engineer dredge *Hell Gate* began work May 10, and raised 140 tons of stone that was broken by surface blasting. The rock proved more difficult to break in this way than was anticipated, and on May 24 the United States steam drill scow *Gen. John Newton* was placed upon the reef to complete the work. Four holes, averaging 6.3 feet, were drilled and blasted. These did excellent work, but left the reef in such shape that no more holes could be drilled, and surface blasting had to be resumed.

The reef was finally swept June 16, 1892, with the horizontal bar, and the least depth of water found was 25.5 feet, mean low water. The drill scow was then withdrawn, as it could not be kept longer on the improvement without prejudice to pressing work upon more obstructive reefs in the East River.

It is believed that the improved depth of 25.5 feet, mean low water, over Baxter Ledge, is sufficient for the present navigation of Kill van Kull.

SEA WALL, NORTH SHORE OF SANDY HOOK.

At the close of the last fiscal year, a contract with John Satterlee, dated March 26, 1891, was in progress for the delivery of 5,000 tons of broken stone, at 79 cents per ton.

The delivery of the required quantity of stone was completed September 18, 1891; the quantity placed in the wall and jetties, during the year, was 3,110 tons, and the total cost for furnishing and laying the stone in place was $1.33 per ton.

The wall as now constructed is 2,575 feet long, extending from Jetty No. 1 westward to a point 119 feet beyond Jetty No. 11, and had, when first laid, a cross-section area of 50 to 60 square feet.

During the past fall and winter the wall has been exposed to many and severe storms, but, while it has suffered damage in many places and will require to be raised and strengthened, has well performed the office required in maintaining the high-water line and preventing the undermining of the cliffs behind it.

The amount expended on the improvement of New York Harbor during the fiscal year ending June 30, 1892, inclusive of outstanding liabilities, was $95,375.95.

The improvement by dredging and rock removal, as well as others of a similar character in and about New York Harbor, has been under the supervisory charge of Mr. G. W. Kuehnle, assistant engineer, to whom I am indebted for the most satisfactory and intelligent manner in which he has discharged his various trusts.

The special work of shore protection at Sandy Hook has been under the personal direction of First Lieut. J. G. Warren, Corps of Engineers, assistant.

This work is in the collection district of New York. Nearest light-houses, Sandy Hook and Highland lights. The nearest forts are the fort at Sandy Hook and those at the Narrows.

AMOUNTS APPROPRIATED.

For Gedney Channel, by act July 5, 1884	$200,000.00
For New York Harbor:	
Act August 5, 1886	750,000.00
Act August 11, 1888	380,000.00
Act September 19, 1890	160,000.00
Total	1,490,000.00
Amount expended to June 30, 1892, inclusive of outstanding liabilities	1,465,259.38

Money statement.

July 1, 1891, balance unexpended	$120,116.57
June 30, 1892, amount expended during fiscal year	93,572.22
July 1, 1892, balance unexpended	26,544.35
July 1, 1892, outstanding liabilities	1,803.73
July 1, 1892, balance available	24,740.62
Amount appropriated by act approved July 13, 1892	170,000.00
Amount available for fiscal year ending June 30, 1893	194,740.62
Amount that can be profitably expended in fiscal year ending June 30, 1894 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	250,000.00

COMMERCIAL STATISTICS.

The commercial statistics for the fiscal year ending June 30, 1890, have remained practically unchanged, and are therefore herein repeated.

The following statement concerning the commerce of New York Harbor is taken from the report of the Chamber of Commerce of the State of New York for the year 1889-'90:

Articles.	Imported.		Exported.		Total value.
	Quantity.	Value.	Quantity.	Value.	
Sugar ... pounds	1,463,051,343	$42,943,453			$42,943,453
Molasses ... gallons	8,498,875	1,424,251			1,424,251
Coffee ... pounds	455,979,016	58,860,319			58,860,319
Tea ... do	58,476,531	9,643,514			9,643,514
Manufactures of wool, silk, cotton, and flax		111,234,883		$7,728,397	118,963,280
Cotton ... pounds			536,614,048	54,701,315	54,701,315
Leather and hides		25,760,160		4,906,214	30,666,374
Tin ... pounds	327,279,151	14,825,588			14,825,588
Raw silk and wool ... do	55,505,689	13,949,577			13,949,577
Hemp, jute, sisal grass, etc. ... tons	149,263	13,431,215			13,431,215
India rubber and gutta-percha, crude ... pounds	28,652,361	11,094,063			11,094,063
Tobacco and manufactures		10,147,883		15,291,084	25,438,967
Furs and manufactures		4,748,971		4,724,017	9,472,988
Earthen, stone, and china ware		3,230,780			3,230,780
Wines		6,156,821			6,156,821
Coin and bullion		7,274,618		69,724,274	76,998,892
Precious stones		9,498,209			9,498,209
Miscellaneous		135,203,820		75,006,102	210,209,922
Breadstuffs:					
Wheat ... bushels			9,086,407	8,449,510	8,449,510
Wheat flour ... barrels			3,335,195	15,498,193	15,498,193
Corn ... bushels			26,658,970	13,066,961	13,066,961
All other breadstuffs				1,765,287	1,765,287
Provisions ... pounds			753,007,846	64,504,425	64,504,425
Mineral oils ... gallons			418,773,072	36,049,956	36,049,956
Cattle			75,004	6,204,624	6,204,624
Oil cake and meal ... pounds			231,034,183	3,032,066	3,032,066
Foreign merchandise				16,727,560	16,727,560
Total		479,428,125		397,379,985	876,908,110

This table shows an increase of $24,642,419 over the total value of imports and exports for the preceding year, which amounted to $852,165,691.

Commercial statistics of the port of New York from July 1, 1891, to June 1, 1892.

Amount of revenue collected	$111, 051, 853
Value of all imports	488, 668, 720
Value of all exports	372, 149, 486

	Number.	Registered tonnage.
Foreign vessels entered	3, 705	5, 674, 250
Foreign vessels cleared	3, 803	5, 716, 223
American vessels from foreign ports	1, 073	884, 331
Coastwise vessels entered	2, 344	2, 871, 073
Coastwise vessels cleared	2, 617	2, 916, 842

Statement of the number and tonnage of all vessels belonging to the port of New York, June 1, 1892.

	Number.	Registered tonnage.
Steam vessels	999	301, 344. 79
Sailing vessels	1, 351	160, 030. 31
Barges	629	134, 631. 03
Canal boats	31	5, 084. 63

E 11.

IMPROVEMENT OF RARITAN BAY, NEW JERSEY.

Raritan Bay forms the western part of the large triangular bay inclosed between Sandy Hook, the New Jersey shore, and Staten Island, the eastern part of which is commonly known to New Yorkers as the Lower Bay, as it lies just outside of or below New York Harbor, which is the name usually applied to the inner body of water on which the city of New York is situated.

The Raritan River flows into Raritan Bay at its extreme western end, passing between Perth Amboy and South Amboy, and Newark Bay is connected with both the Raritan River and Bay by the Arthur Kill or Staten Island Sound, which, separating Staten Island, belonging to the State of New York, from the New Jersey shore, enters Raritan Bay at Perth Amboy.

The depth of the bay varies from 5 to 30 feet, decreasing gradually towards its western and southern shores.

The natural channel leading out of it towards the eastward after passing the Great Bed Lights at the junction of Staten Island Sound and the Raritan River does not follow the middle of the bay, but hugs the Staten Island shore for nearly 4 miles to Seguine Point, situated about half a mile east of Princes Bay Light, then it runs southeastwardly towards the inner point of Sandy Hook, about 2 miles, crossing a shoal which puts out towards the southward from the Staten Island shore.

In 1880, before any improvement had been made here by the Government, 18 feet of mean water could be carried through from Perth Amboy to Great Beds Light; 21 feet from Great Beds Light to Seguine Point, and 14½ feet from Seguine Point eastward across the shoal to the deep water in the outer bay.

The width of this shoal between the 21-foot curves was about 8,000 feet.

Through the middle of the bay, south of this channel from Great Beds Light directly towards Sandy Hook, only 11 feet of water could be carried over the shoals.

The above depths all refer to mean low water.

A survey of this bay was ordered in 1880, with the view of ascertaining the practicability of securing a greater depth of water from the Main Ship Channel in the lower bay to the wharves at Perth Amboy, as vessels were often much delayed in crossing the shoal east of Seguine Point.

The estimated cost of dredging a channel 300 feet wide and 21 feet deep mean low water, from Seguine Point southeastward to the deeper waters of the bay outside was $126,500. (Annual Report Chief of Engineers, 1881, Part I, pages 717–719.)

From March 3, 1881, to July 5, 1884, $120,000 were appropriated for this improvement, and a survey which was made in May, 1885, showed that the improved channel at that date had an average width of 250 feet, and a least depth of 18 to 20 feet mean low water.

The channel had slightly shoaled since the dredging was suspended in 1884. In 1885 the project was extended by providing for excavating a channel 300 feet wide and 21 feet deep, from Great Beds Light to deep water at Ward Point, opposite to Perth Amboy. This channel, taken in connection with its extension to the eastward of Seguine Point, would give a continuous 21-foot channel from the Main Ship Channel in New York Bay to the wharves at Perth Amboy. The modified project of 1885 further called for dredging a channel from Great Beds Light to South Amboy, 4,500 feet long, 300 feet wide, and 15 feet deep, mean low water. The cost of dredging these two channels, and restoring the original width in the cut, east of Seguine Point, was estimated to cost $114,000, which sum was increased in 1888 to $120,000, to provide for the shoaling which had taken place in the interval of three years. (Annual Report of the Chief of Engineers, 1885, Part I, page 758.)

The appropriation, act of August 5, 1886, was $37,500, and was applied to completing the channel west of Ward Point, 300 feet wide, and 21 feet deep, and in excavating a channel 315 feet wide and 21 feet deep across the crest of the shoal leading from the bend towards Seguine Point, but the funds were not sufficient to complete the whole of the projected work at that point.

It was stated in the original project of 1881 that the Seguine Point Channel would have to be maintained by dredging. The detailed survey, which was made in 1888 from the eastern end of the Seguine Point Channel to Perth Amboy, showed that considerable shoaling had taken place, both in the improved channel and over a large stretch west of Princes Bay Light, where deep water formerly existed. This fact made it necessary, in 1889, to submit revised estimates for the further improvement of the channels leading to Perth Amboy and to South Amboy. (Annual Report of the Chief of Engineers for 1889, Part I, page 796.)

REVISED ESTIMATES.

(1) For a channel 300 feet wide and 21 feet deep, mean low water, from New York Lower Bay to Perth Amboy, the following dredging will be required:

	Cubic yards.
(*a*) From 21-foot curve, New York Lower Bay, to 21-foot curve off Seguine Point	347,368
(*b*) From Princess Bay around Red Buoy 8 towards Great Beds Light	154,130
Total dredging	501,498

(2) For a channel 300 feet wide and 15 feet deep, from Great Beds Light to South Amboy, the dredging required will be	200,000

These estimates are made on the basis of an allowance of 1 foot over depth, and for one-third increase in bulk for scow measurement.

Total dredging required for the completion of the two projected channels, cubic yards	701,498
Estimated cost of the proposed dredging	$175,375

The river and harbor act of August 11, 1888, appropriated $25,000 for continuing the improvement, and on the 27th of February, 1889, contract was made with James A. Simmons, of New York City, for the removal of 120,000 cubic yards of material from Raritan Bay; 80,000 cubic yards to be removed from the channel across the shoal off Seguine Point, securing 21 feet depth; and 40,000 cubic yards from the channel leading across shoal at Great Beds Light to South Amboy, securing 15 feet depth, mean low water.

The river and harbor act of September 19, 1890, appropriated $40,000 for continuing the improvement.

It may be said in regard to this improvement that the deep-water channel which has been said to hug the south shore of Staten Island as far east as Seguine Point, is the *ebb* channel, while the channel on the southern border of Round Shoal through the center of the bay, heads on the line joining Seguine Point, north shore, and Conaskonk Point, south shore, is the *flood* channel. These two channels slightly overlap, passing each other at a distance of 7,000 feet.

The connection of these channels by an improved channel starting at Seguine Point and running southeast towards Sandy Hook, is an unnatural connection, and it was stated in the original report, in 1881, that the channel so projected would require annual dredging for its maintenance.

The experience of all the contracts which have been made for this improvement confirms the prediction of 1881. It would have been better, had sufficient funds been available in the beginning, to have extended the flood channel by dredging almost due west until it intersected the ebb channel a short distance to the eastward of the Great Beds Light. Then the ebb and flood would have probably followed the same path and there would have been a better prospect of having the channel maintained by tidal scour.

The width of the intervening shoal is about 12,000 feet, and the average depth of water is 13 feet, approximately, between the 21-foot curves. The amount of material necessary to be removed to open a channel on this line 300 feet wide and 21 feet deep, is 2,400,000 cubic yards, at an estimated cost of $600,000.

This will be the future channel which will connect the head of the Raritan Bay with the Amboys. A limited amount of dredging may be done annually in the Seguine Point Channel to maintain a 21-foot depth for vessels until commerce demands a more direct and convenient route across the shoal now lying at the western end of the bay.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

At the beginning of the fiscal year the contract with Thomas Potter, dated January 16, 1891 (Annual Report Chief of Engineers, 1891, Part I, page 934) was still in force, and operations were in progress on the South Amboy Channel which continued until July 8, when the funds allotted to that channel became exhausted.

The quantity of material removed from the South Amboy Channel during the fiscal year was 8,095 cubic yards, and the total amount removed under this contract was 90,130 cubic yards, resulting in a channel 170 feet wide and 15 feet deep, mean low water.

Work was begun on the Seguine Point Channel July 17 and continued until September 24, when the contract was completed. The quantity of material removed from the channel under this contract was 106,195 cubic yards, and resulted in giving to the improved channel an increased width of 80 feet, making the present width of the channel 180 feet, and the present depth 21 feet, mean low water.

No complaint was made by mariners during the year that the channels had either deficient width or depth, and no reports were received that any vessels had grounded at any point in the improved channels between the Lower Bay and the wharves at Perth Amboy and South Amboy, N. J.

The amount expended during the fiscal year ending June 30, 1892, inclusive of outstanding liabilities, was $30,827.09.

An appropriation of $100,000 is recommended for continuing the improvement along the channels leading to Perth Amboy and South Amboy respectively.

This work is in the collection district of Perth Amboy, which is the nearest port of entry. Nearest light-house, Princes Bay. Nearest fort, at Sandy Hook, New Jersey.

Amounts appropriated.

Application.	Date.	Amount.
Dredging	Mar. 3, 1881	$50,000
Do	Aug. 2, 1882	50,000
Do	July 5, 1884	20,000
Do	Aug. 5, 1886	37,500
Do	Aug. 11, 1888	25,000
Do	Sept. 19, 1890	40,000
Total		222,500

Amount expended to June 30, 1892, inclusive of outstanding liabilities, $221,276.85.

Money statement.

July 1, 1891, balance unexpended	$32,050.24
June 30, 1892, amount expended during fiscal year	30,754.28
July 1, 1892, balance unexpended	1,295.96
July 1, 1892, outstanding liabilities	72.81
July 1, 1892, balance available	1,223.15
Amount appropriated by act approved July 13, 1892	40,000.00
Amount available for fiscal year ending June 30, 1893	41,223.15
Amount (estimated) required for completion of existing project	95,375.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	95,375.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The commercial statistics for the fiscal year ending June 30, 1890, have remained practically unchanged, and are therefore herein repeated.

The following statement of the commerce of South Amboy, N. J., and of Raritan River was prepared by Hon. D. C. Chase, mayor of South Amboy, N. J.:

Receipts and shipments.

	Tons.
Products of the forests	33, 851
Products of quarries and mines	3, 020, 003
Animal products	16, 541
Agriculture	37, 557
Manufactures	417, 909
Mechanical and miscellaneous	320, 005
Total	3, 845, 866

Total value, $45, 075, 943.

Vessels arriving and departing.

Class.	Number.	Tonnage.	Draft (loaded).
			Feet.
Steamers	6, 038	359, 300	6 to 12
Barks	40	8, 800	8 to 16
Brigs	40	8, 800	8 to 16
Schooners	4, 138	248, 280	7 to 14
Sloops	1, 002	52, 210	5 to 7
Propellers	4, 028	280, 682	7½ to 10
Barges and lighters	45, 838	2, 887, 794	7 to 16
Total	61, 124	3, 845, 866	....

The following statement of the commerce of Perth Amboy, N. J., for the year 1889 was received from Mr. James Donnelly, superintendent of the New Jersey division, Lehigh Valley Railroad Company:

Lehigh Valley Railroad tonnage eastward and westward over the wharves for the year 1889.

[Gross tons.]

	Received.	Shipped.	Total.
Coal piers.			
Coal	....	1, 815, 521	
Coke	....	3, 058	1, 818, 579
Freight wharves.			
Grain	....	125, 743	
Steel rails	....	34, 052	
Pig iron	471	87, 796	
Iron ore	86, 194	....	
Lumber	33, 207	875	
Fertilizers	106	....	
Clay	....	5, 662	
Miscellaneous	5, 867	7, 732	387, 705
United Refiners' Export Oil Company's Wharf.			
Oil	....	60, 867	60, 867
Grand Total	....	....	2, 267, 151

Number, tonnage, and draft of vessels.

	Number.	Tonnage.	Draft.
Vessels transporting coal.			*Feet.*
Steam	102	500 to 3,000	....
Sailing	848	50 to 1,200	....
Barges	311	500 to 1,200	....
Boats	4,821	100 to 400	....
Vessels transporting freight.			
Ocean steamers	10	1,500 to 3,500	19 to 23.5
Sailing vessels	181	500 to 1,200	15 to 18
Lighters	57	200 to 500	6 to 13
Canal boats	1,238	200 to 300	6
Company's Wharf.			
Barks and ships	59	500 to 1,500	15 to 18

Commercial statistics of the port of Perth Amboy, N. J., from July 1, 1891, to June 1, 1892.

Amount of revenue collected	$19,072
Value of all imports	75,888
Value of all exports	998,158

	Number.	Registered tonnage.
Foreign vessels entered	16	15,233
Foreign vessels cleared	56	42,949
American vessels from foreign ports	9	3,573
American vessels to foreign ports	12	3,817
Coastwise vessels entered	92	52,975
Coast vessels cleared	277	48,407

Statement of the number and tonnage of all vessels belonging to the port of Perth Amboy, N. J., June 1, 1892.

	Number.	Registered or net tonnage.
Steam vessels	55	5,388.00
Sailing vessels	285	18,840.41
Barges	69	22,399.68
Canal boats	1	134.55
	410	46,763.29

E 12.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

(1) *Canal boat in Gravesend Bay, New York.*—This wreck was an old canal boat that had drifted into Gravesend Bay, Lower New York Harbor, and stranded on the beach in about 12 feet of water. It was a dangerous menace to the many small boats which navigate the lower harbor. The wreck was successfully removed on August 12, 1891, by Mr. John F. Baxter, the lowest bidder, on proposal approved by the Chief of Engineers, July 30, 1891.

The cost of the removal was $144.

(2). *Canal boats in Raritan Bay, New Jersey, and in Staten Island Sound at Tottenville, New York.*—The wreck of a canal boat in Raritan Bay near South Amboy, N. J., was complained of by the New Jersey Board of Commissioners of Pilotage, January 14, 1892, as being dangerous to navigation, and the wreck of a canal boat in Staten Island Sound near Tottenville, N. Y., was reported by the New York Board of Commissioners of Pilots, January 27, 1892.

These wrecks were old and valueless coal barges, which, drifting back and forth through the narrow channels leading from Raritan River to Staten Island Sound, seriously interfered with local and coastwise navigation.

Under sealed proposals, opened January 30, 1892, approved by the Chief of Engineers February 6, 1892, the Chapman Derrick and Wrecking Company, the lowest bidder, removed successfully the wreck in Raritan Bay.

The other boat, which had been reported sunken in 40 feet off the dock at Tottenville, N. Y., could not be found, although the contractor diligently sought for it.

The cost of the removal of the wreck in Raritan Bay, near South Amboy, was $199.

Abstract of proposals for the removal of wreck of canal boat in Gravesend Bay, New York, received in response to circular letter dated July 20, 1891, and opened July 24, 1891, by Lieut. Col. G. L. Gillespie, Corps of Engineers.

No.	Name of bidder.	Address.	Price bid.	Remarks.
1	Merritt's Wrecking Organization	49 Wall street, New York City	$500.00	
2	Chapman Derrick and Wrecking Co.	70 South street, New York City	170.00	
3	John F. Baxter	308 West street	144.00	Lowest bid.

Abstract of proposals for removal of wreck of canal-boat at Tottenville, Staten Island Sound, New York, and of canal-boat at South Amboy, Raritan Bay, New Jersey, received in response to circular letter dated January 28, 1892, and opened January 30, 1892, by Lieut. Col. G. L. Gillespie, Corps of Engineers.

No.	Name of bidder.	Address.	Removing wreck at—		The two combined.
			Tottenville, N. Y.	South Amboy, N. J.	
1	W. H. Smith	Tottenville, N. Y	$75.00		
2	J. H. Gregory	Perth Amboy, N. J	149.00	$199.00	$348.00
3	Chapman Derrick and Wrecking Co.	70 South street, New York City.			*289.00

* Lowest bid.

E 13.

[Printed in House Ex. Doc. No. 29, Fifty-second Congress, first session.]

PRELIMINARY EXAMINATION FROM MAIN CHANNEL FROM JAMAICA BAY EASTERLY TO LONG BEACH INLET, NEW YORK, FOR CANAL.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., December 16, 1890.

GENERAL: In obedience to letter of the Chief of Engineers dated September 20, 1890, I have the honor to submit the following report upon the preliminary examination "From Main Channel from Jamaica Bay, New York, easterly to Long Beach Inlet, for canal," for which provision is contained in the river and harbor act approved September 19, 1890.

I made a personal examination of the locality October 22, 1890, accompanied by Mr. J. L. B. Norton and other prominent citizens residing in the vicinity, and was fully informed by them of the purposes of the survey.

The lands along the southern shore of Long Island are being rapidly converted into sites for private residences, some of which are used the year round by the owners, and also for large summer hotels surrounded by cottages which furnish accommodations during the summer season for numbers of persons from New York City and neighboring cities, as well as from a distance.

These improvements are accompanied by large material interests of a permanent character, resulting in the formation of numerous small towns which draw their supplies from New York City, Brooklyn, and elsewhere, and which are principally dependent upon the Long Island Railway for transportation.

The advocates of the survey claim that the railway rates of transportation are excessive, and that a great relief would be given to them from these exactions if the waterways through Jamaica Bay, Rockaway

Inlet, and the Great South Bay were improved so that supplies could be delivered at Arverne, Far Rockaway, Lawrence, and other small towns adjacent, independently of the railroad.

The subject of inland navigation along the south shore of Long Island was discussed by Lieut. Col. Walter McFarland, Corps of Engineers, in a report submitted to the Chief of Engineers, December 31, 1886 (Annual Report Chief of Engineers, 1887, p. 754), in compliance with river and harbor act of August 5, 1886, which provided for a survey for a "channel between Jamaica Bay and Rockaway Inlet." Colonel McFarland states in his report that the survey of 1886 had for its object the determination of "the cost of opening an inner line of water communication for boats of light draft from the Great South Bay on the south side of Long Island to Jamaica Bay west of it by means of a cut through the narrow neck of land (Far Rockaway) which separates these bays," and shows that if the project contemplated by the survey were carried out, it would not provide for a navigable passage through Jamaica and South bays for the reason that those bays had many other shoals east and west of the termini of the proposed cut, "between which the channels are so shallow, narrow, and tortuous that they may be considered practically unnavigable," and that a navigable waterway which would meet the alleged commercial necessities of South Bay and Jamaica Bay could not be estimated for except on a survey extending from Patchogue to Jamaica Bay, a distance of 45 miles.

The water conditions to-day are practically the same as in 1886. The entrance to Jamaica Bay is through Rockaway Inlet, between Coney Island and Rockaway Beach.

The depth of water on the bar is 12½ to 13 feet mean low water, but inside the bar there is good anchorage for vessels drawing 25 feet of water as far eastward as the western entrance to Beach Channel, which leads to the new town of Arverne, on Rockaway Beach, 1 mile to the eastward of the Old Rockaway Hotel. Thence the water shoals to 5 feet, mean low water, at the western entrance to Conch Hole on the approach to the Citizens Cut at Far Rockaway, which leads into Far Rockaway Bay. From the eastern entrance to Conch Hole to the western entrance to the Far Rockaway Cut, a distance of one-half mile approximately, the bed of the bay is bare at low tide. The mean range of tides in Jamaica Bay is 4½ feet, approximately.

The Long Beach Inlet is a small and unimportant water way between Shelter Island and Long Beach, connecting Broad Channel at the western end of Hempstead Bay with the ocean, and is known upon the charts as East Rockaway Inlet or Hog Inlet (Coast Survey Chart No. 119). The depth on the bar at mean low water is about 5 feet.

Passing to the eastward around the network of islands of varying size which largely compose Hempstead Bay, and which at low tide are separated by small drains or threads of water impracticable of improvement at reasonable cost for any except very small boats, no continuous channel for 5 feet depth at mean low water is found until Great South Bay is reached, opposite Babylon, a distance of 20 miles in an air line.

As the act of September 19, 1890, fixes the eastern terminus of the examination at Long Beach Inlet, no improvement through Hempstead Bay, which has reference to a larger and more important inland navigation through the Great South Bay, seems contemplated.

The two principal bodies of water at the western end of the south shore of Long Island, separated from the ocean by beaches, which can be profitably used for commercial purposes, are Jamaica Bay and Great South Bay; the entrance to the former, at Rockaway Inlet, is 18 miles, and to the latter, at Fire Island Inlet, is 50 miles from New York, by way of the Narrows. They have no direct navigable intercommunication, as I have shown, and if one were made artificially it would be over 30 miles long and would be of uncertain maintenance and utility. Any canal of shorter length than 30 miles would be of no practical value, and it is not believed that an ultimate improvement so extensive and costly was contemplated by the act under which this report is made.

The examination desired has, therefore, only a local bearing. Rockaway Beach and its eastern continuation, Far Rockaway Beach, is part of the mainland, which has only lately been made an island by the small artificial cut at Far Rockaway, and the bay of Far Rockaway is but a shoal lagoon, which is filled and emptied by tides passing through Little Inlet and East Rockaway Inlet, with a slight increment coming through the cut.

Little Inlet, which opens into Far Rockaway Bay, is hardly more than a low depression in the beach, and its tendency is to shoal up the lagoon of which it is a partial outlet.

The personal examination which I have made on the ground and a careful study of the latest charts lead me to think that it will be impracticable to open or to maintain, if opened, a fairly good navigable channel, if such were needed, through Far Rockaway Bay, except at a cost disproportionate to the benefit to be derived from it, owing to its great exposure to inroads from the sea. The covering beach is low and narrow and shows evidence of old breaches through it other than those which now exist, and it is not at all certain that the western end has not been seriously damaged by tidal currents propagated through the artificial cut at Far Rockaway. For this reason I shall discard any consideration of this part of the subject. It alone remains to consider the connection between Jamaica Bay and Far Rockaway.

The persons whom I have seen in relation to it or who have sent written statements for my information and study all unite in testifying that the improvement most urgently needed, and to which reference was mainly intended to be made by the act, is the excavation of a small canal less than one-half mile long, 50 feet wide and 5 feet deep, mean low water, extending from the eastern end of Conch Hole, Jamaica Bay, to the artificial cut at Far Rockaway, to the end that supplies of coal, lumber, cement, brick, hardware, feed, and general articles of merchandise may be delivered to the growing communities accessible to Far Rockaway free from the excessive taxation for transportation now imposed by the Long Island Railroad.

It is estimated (inclosures herewith) that the tonnage of such a canal would exceed 500,000 tons annually and that the saving on freight to the citizens would be $500,000 annually. These figures seem high and I give them as they have been furnished to me with the remark that if the tonnage equals one-fourth the estimate the cost of opening the desired water way will be justifiable.

If this improvement be made it will be as practicable to reach Far Rockaway at high tide with vessels drawing 9 feet of water as it now is to reach Canarsie and Sheepshead Bay, whose channels have been improved by Government aid.

For the foregoing reasons I am of the opinion that the water way "from main channel from Jamaica Bay, New York, easterly to Long Beach Inlet for canal," is not "worthy of improvement."

The eastern part of Jamaica Bay from the main ship channel easterly through Conch Hole to the Citizens Cut at Far Rockaway, which forms the western part of the water way mentioned in the act, is "worthy of improvement" to the extent of opening a canal 60 feet wide, affording 5 feet depth at mean low water. The estimated cost of making the necessary survey and preparing charts and estimates of cost is $400.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

LETTERS OF MR. JOHN L. B. NORTON.

(1.)

FAR ROCKAWAY, LONG ISLAND, N. Y., *October 24, 1890.*

DEAR SIR: In regard to my application for opening canal passed in the last river and harbor bill, I would suggest that the said canal commence at channel of Jamaica Bay and extend easterly through Nortons Creek to Rockaway Inlet, thence easterly to East Rockaway Inlet.

The proposed route is about 5 miles, of which about 4 miles already has a depth of water of from 5 to 14 feet, and by connecting 1 mile through Jamaica Bay to Inlet would give water connection for the 5 miles.

I would also suggest that the work commence at the creek, working westerly to main channel, having good water there, which is now a depth of 11 feet at low tide.

I would also suggest that the canal be 50 feet wide and have a depth of 5 feet at low water. The current will deepen and widen the same. The course of the current is from the creek westerly to Bass Channel.

Inclosed you will find benefits to be derived by shippers. For the oyster and clam trade I refer you to reports made by P. N. Davenport and others.

There are 200 registered vessels in Jamaica Bay, most of whom would use canal if opened, the 1 mile from Jamaica Bay to Inlet.

The cost to consumers of coal here now is $6.50 to $7 per ton. The coal costs at coal pockets, Jersey City, $3.50, and if transported by water in barges without transferring could be shipped at a very small figure, about 25 or 30 cents per ton, and could be sold here at $5 per ton if canal were opened, making a saving of $2 per ton to consumers, and other material in proportion.

Yours respectfully,

JOHN L. B. NORTON.

Lieut. Col. G. L. GILLESPIE.

(2.)

FAR ROCKAWAY, LONG ISLAND, N. Y.

DEAR SIR: In reply to yours, I hereby send you a list of shipments.

	Present cost.	Cost by water route.
To Arverne:		
Lumber, 20,000 tons, at $1.90 per ton	$38,000	$20,000
Bricks, 25,000, at $1.80 per M	45,000	25,000
Lime and cement, 4,000 barrels, at 16 cents per barrel	640	400
Flour and feed, 200 tons, at $1.60 per ton	320	200
Hay, 200 tons, at $1.80 per ton	360	200
Soil for highway and private roadways, 30,000 tons, at 80 cents per ton	24,000	15,000
Hardware and sundries, 1,000 tons, at $2 per ton	2,000	1,500
Coal, 3,000 tons, at $1 per ton	3,000	1,500
500 passengers per day for 90 days, 45,000, at 70 cents round trip	31,500	22,500
To Far Rockaway:		
Lumber, 250,000 tons, at $1.90 per ton	475,000	250,000
Bricks, 80,000, at $1.80 per M	144,000	80,000
Lime and cement, 75,000 tons, , at $1.60 per ton	120,000	75,000
Flour and feed, 50,000 tons, at $1.50 per ton	75,000	50,000
Hay, 25,000 tons, at $1.80 per ton	45,000	25,000
Stone and macadenizing for highways, 30,000 tons, at $1 per ton	30,000	21,000
Hardware, groceries, etc., 10,000 tons, at $3 per ton	30,000	20,000
Coal, 30,000 tons, at $1 per ton	30,000	15,000
4,000 passengers per day for 90 days, 360,000, at 70 cents round trip	252,000	180,000
Present cost	1,345,820	792,300
Cost by water route	792,300	
Saving to shippers	553,520	

This freight has increased 100 per cent in the last three years. Freight, such as lumber, etc., can be shipped at Buffalo or Albany direct, without breaking bulk for $2 per ton.

Yours, truly,

JOHN L. B. NORTON.

Lieut. Col. G. L. GILLESPIE.

(3.)

SIR: Inclosed you will find number of tons of various articles shipped to the following places during the fiscal year 1890:

	Tons
Arverne:	
G. A. Brandeth, lumber and builders' material	250
Remington Vernam, lumber, etc	3,750
Stone and soil for public roads	50,000
Miscellaneous	3,120
	57,120

Number of guests at Arverne Hotel during summer, 21,000.

Far Rockaway:	
William A. Wynn, meats, etc	295
Exports	520
Martin F. Croft, coal and wood	3,000
Thomas Dolan, coal and wood	3,000
Grain, flour, and feed	10,000
S. H. Norton, coal and wood	6,000
Miscellaneous	108,105
	130,920

About 451,801 passengers during the year to and from the city.

Inwood:	
F. Davenport & Son, general groceries	750
M. J. Furman, meats, etc	150
John R. Duffus, vegetables, etc	50
George W. Smith, general groceries	750
Oysters taken by wagons that would be shipped by canal	1,000
(See P. N. Davenport, report of October 10, 1890.)	
Shipped from this place	10,000
Miscellaneous	500
	13,200

Lawrence:	
John H. Smith, builders' material	2,000
J. A. Wood & Son, builders' material	2,200
Iron piping, plumbing materials, etc	500
J. R. Wood & Son, builders' material	250
Manure, etc	200
	5,150

Three hundred passengers daily.

Cedarhurst and Woodsburg:	
F. H. Weyant, coal and wood	3,000
F. A. Darling, general groceries	2,000
F. K. Walsh, hardware, etc	250
Lumber	6,280
	11,530

East Rockaway:	
Freight carried by vessels:	Tons.
Lumber, lime, brick, cement	144,365
Grain, flour, and feed	120
Coal	5,000
Hardware	50
Manure	300
Oysters	15,000
Freight carried by railroad:	
Lumber and oysters	90,000
	254,835

Rockville Center:	
Oysters	1,080
Coal	7,000
Lumber	3,120
Lime and brick	1,000
Hardware, groceries, etc	500
	12,700

Yours, truly,

J. L. B. NORTON.

Lieut. Col. G. L. GILLESPIE.

SURVEY OF EASTERN PART OF JAMAICA BAY, NEW YORK, BEING WESTERN PART OF ROUTE FROM JAMAICA BAY EASTERLY TO LONG BEACH INLET.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., October 29, 1891.

GENERAL: In obedience to instructions contained in your letter of December 19, 1890, I have the honor to submit a report, accompanied by illustrative chart, on the survey of "western part of route from main channel from Jamaica Bay easterly to Long Beach Inlet, for canal," made to comply with the requirements contained in the river and harbor act approved September 19, 1890.

For the reasons stated in my preliminary report upon the same subject, dated December 16, 1890, the survey was limited to the eastern part of Jamaica Bay, as that part alone of the water route referred to in the act was stated to be "worthy of improvement."

The purpose to be effected by the proposed improvement is not to open a navigable waterway to connect Jamaica Bay with the Great South Bay by way of Rockaway Bay, but rather to form an artificial waterway, navigable by vessels drawing 5 feet, from Beach Channel to some convenient point on the eastern shore of Jamaica Bay, by which the towns situated close to the bay on that side may be supplied with necessary articles of home consumption at cheaper rates than those now fixed by the railroad company.

When the survey was first undertaken it was supposed, on the statements of the promoters of the proposed improvement, that the only feasible route for the new waterway was by way of Conch Hole, and it was urged that the estimate be made for a canal one-half mile long, 60 feet wide, and 5 feet deep, running in a straight line from near the center of Conch Hole to the shore at the highway bridge-crossing of the Citizens Cut, leading into Rockaway Bay.

A close examination of the chart* prepared from the survey indicated, however, the possibility of opening a channel to the northward through Bass Channel which might be shorter in length, require less excavation, and might be more beneficial to the community than the more southerly route. A careful study of this route and of the estimates of cost gave satisfactory results. The channel by this route may terminate at some accessible and convenient point on the eastern shore near the foot of Bayswater avenue, or it may continue to the eastward along the extension of Aunt Sallie's drain, and stop at the eastern terminus proposed for the Conch Hole route. An estimate for each of these routes is submitted.

---

*Not reprinted; printed in House Ex. Doc. No. 29, Fifty-second Congress, first session.

A route through Nigger Bar Channel has also been investigated, but its length and the difficulties of its maintenance are considerations which make such a route inexpedient of adoption.

It is well to observe that the straight canal along the Conch Hole route will cross lands lying above high water, through which the owners may be unwilling to have excavations made unless adequate compensation is paid them for right of way for the canal. The Bass Channel routes are not open to this objection, for the bed of the bay is not exposed at low tide at any point, and no question should ever rise in regard to compensation for land under water occupied as the site for the waterway.

If an appropriation be made for making an artificial waterway through the eastern part of Jamaica Bay along the Conch Hole route the act should provide that the money shall not become available until after the right of way over such parts as lie above high water shall have been ceded to the Government free of charge.

The greater part of the bay south and east of Beach Channel is an extensive marsh, generally bare at low water, within whose area there are frequent marsh islands which are never submerged except when tides are abnormally high. A water route can be readily and economically opened through the marsh by turning the excavated material over in place, without incurring the expense of transporting it to distant points for deposit; and if its direction be favorably located in regard to the water passage connecting with Far Rockaway Bay, through which there is a free circulation of tidal water, there is a reasonable certainty that the improved depths will be maintained by the action of the tidal currents.

The following estimates of cost for excavating a channel along the three routes considered are submitted:

(1) Conch Hole.

From Beach Channel, through Conch Hole, to the western entrance to Citizens Cut at Far Rockaway, west of highway bridge-crossing; 6,250 feet long, 60 feet wide, and 5 feet deep, mean low water:

Dredging, 97,300 cubic yards of material, scow measurement, at 20 cents per cubic yard	$19,460
Contingencies of engineering, 10 per cent	1,946
Total cost	21,406

(2) Bass Channel.

From Beach Channel, through Bass Channel, to western entrance to Citizens Cut at Far Rockaway; 7,375 feet long, 60 feet wide, and 5 feet deep, mean low water:

Dredging, 86,000 cubic yards of material, scow measurement, at 20 cents per cubic yard	$17,200
Contingencies of engineering, 10 per cent	1,720
Total cost	18,920

(3) *Bass Channel.*

From Beach Channel, through Bass Channel, to a point on the eastern shore of Jamaica Bay near the foot of Bayswater avenue; 4,650 feet long, 60 feet wide, and 5 feet deep, mean low water:

Dredging, 43,000 cubic yards of material, scow measurement, at 20 cents per cubic yard	$8,600
Contingencies of engineering, 10 per cent	860
Total cost	9,460

Jamaica Bay is in the collection district of New York. The nearest fort is at Fort Hamilton, Gravesend Bay, and the nearest light-house is located upon Norton Point, Coney Island, New York Bay.

The amount of revenue collected at the port of New York for the year ending June 30, 1891, was $147,538,045.69.

The amount of commerce which will be benefited by the improvement considered in this report can not be accurately given, but it has been estimated at 500,000 tons, which have a valuation of $4,500,000.

No appropriation has ever been made for the improvement of the eastern half of Jamaica Bay.

The vessels which navigate the eastern part of Jamaica Bay are usually of the class engaged in the oyster trade, number about one hundred, and draw 7 feet with center board and 4 feet without center board.

This survey was executed under the supervision of Mr. G. W. Kuehnle, assistant engineer, by a hydrographic party under the immediate personal direction of Mr. John Johnstone. I respectfully invite attention to the accompanying report of Mr. Kuehnle for information embodying the methods followed in making the survey and calculations determining the estimates of cost of carrying out the several projects for improvement.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Lt. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

REPORT OF MR. G. W. KUEHNLE, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
New York, N. Y., October 28, 1891.

SIR: I have the honor to submit the following report on the survey of the western part of route from main channel from Jamaica Bay easterly to Long Beach Inlet, for canal, made by your order of December 22, 1890, in compliance with the requirements of river and harbor act of September 19, 1890.

The survey was made during the month of September, 1891, by the hydrographic party in charge of Mr. John Johnstone, surveyor, under directions from this office. It embraces the eastern end of Jamaica Bay, from Conch Hole to Mott Point, and the western end of Far Rockaway Bay, including the artificial cut connecting the two bays.

The usual methods were used in making the survey; a base line was measured with great care and a triangulation extended over the area to be covered. All soundings and shore-line points were located instrumentally from the triangulation points. The soundings were taken with a rod graduated in feet and tenths, and were reduced to the plane of mean low water established by the U. S. Coast Survey in 1878 at Holland Landing, Jamaica Bay.

The material composing the bed of the bay is mainly sand, covered in part by a light coating of mud, and can be readily removed by the ordinary methods of dredging.

The artificial cut connecting Jamaica Bay and Far Rockaway Bay is crossed by two fixed wooden bridges, which prevent the passage of vessels from one to the other. The highway bridge is a pile bent bridge with the bottom of the string piece 3.3 feet above mean high water; it had at one time a draw, and there is still a space of 25.7 feet in the center without piles. The bridge of the Long Island Railroad is a pile bent bridge, with bents from 8 to 10 feet apart, and with the bottom of the string piece 0.7 feet above mean high water.

Estimates were made by your direction for three separate channels:

(1) The channel desired by the projectors of the survey, a straight canal 60 feet wide and 5 feet deep, mean low water, from Conch Hole to the western end of the artificial cut. This channel crosses land above high water, and involves private property rights which will have to be vested in the United States before work can begin on it.

(2) A channel 60 feet wide and 5 feet deep, mean low water, by way of Bass Channel, to the western end of the artificial cut. This channel does not cross any land above high water, and does not include any private property.

(3) A channel 60 feet wide and 5 feet deep, mean low water, by way of Bass Channel, to the most convenient point on the shore, at the foot of Bayswater Avenue, Far Rockaway.

Estimate for dredging channels in Jamaica Bay, New York, based on survey of September, 1891.

(1) For a channel 60 feet wide, 5 feet deep, mean low water, and 6,250 feet long, from Conch Hole to the western end of artificial cut:	
Dredging 97,300 cubic yards of material, scow measurement, at 20 cents per cubic yard	$19,460
For engineering and contingencies, 10 per cent	1,946
Total	21,406
(2) For a channel 60 feet wide, 5 feet deep, mean low water, and 7,375 feet long, from entrance to Bass Channel to western end of artificial cut:	
Dredging 86,000 cubic yards of material, scow measurement, at 20 cents per cubic yard	17,200
For engineering and contingencies, 10 per cent	1,720
Total	18,920
(3) For a channel 60 feet wide, 5 feet deep, mean low water, and 4,650 feet long, from entrance to Bass Channel to foot of Bayswater Avenue:	
Dredging 43,000 cubic yards of material, scow measurement, at 20 cents per cubic yard	8,600
For engineering and contingencies, 10 per cent	860
Total	9,460

Respectfully submitted.

G. W. KUEHNLE,
Assistant Engineer.

Col. G. L. GILLESPIE,
Corps of Engineers, U. S. A.

E 14.

ESTABLISHMENT OF HARBOR LINES IN NEW YORK HARBOR AND ITS ADJACENT WATERS.

a. HARBOR LINES FOR (1) GREAT MILL AND LITTLE MILL ROCKS, EAST RIVER; (2) EASTERN SHORE OF GRAVESEND BAY, FROM FORT HAMILTON TO CONEY ISLAND; AND (3) SOUTHERN SHORE OF RARITAN AND SANDY HOOK BAYS, FROM CHEESEQUAKE CREEK TO THE HIGHWAY BRIDGE ACROSS SHREWSBURY RIVER AT NAVESINK HIGHLANDS.

HARBOR LINE BOARD,
New York City, February 8, 1892.

GENERAL: The Harbor Line Board for New York Harbor and its adjacent waters, constituted by Special Orders No. 49, Headquarters, Corps of Engineers, October 5, 1888, to comply with section 12 of the river and harbor act of August 11, 1888, has the honor to recommend for approval and adoption harbor lines for the "preservation and protection" of the navigable waters of New York Harbor, as follows:

(1) Great Mill and Little Mill Rocks, East River.

(2) Eastern shore of Gravesend Bay, from Fort Hamilton to Coney Island.

(3) Southern shore of Raritan and Sandy Hook Bays, from Cheesequake Creek to the highway bridge across Shrewsbury River at Navesink Highlands.

A public meeting, duly advertised, was held in the office of the Harbor Line Board at the Army Building, New York City, on the 15th of December, 1891, at which an opportunity was given to all interested parties to express their views in regard to the establishment of harbor lines at the localities enumerated above.

The different lines will be considered in order.

1. GREAT MILL AND LITTLE MILL ROCKS, EAST RIVER.

These rocks, measuring one-half acre, approximately, above the high-water line, are situated in Hell Gate, a short distance north of Flood Rock, and nearly in the center of the water space formed by the junction of the Harlem and East rivers.

No harbor lines have ever been established around them, either by the State or by the General Government.

The Board thinks that the erection upon the rocks of structures projecting into the surrounding water beyond the high-water line would increase the existing dangers to navigation through Hell Gate which Government improvements now in progress there were projected to ameliorate.

Public interests seem rather to demand that the project for improvement of Hell Gate should be enlarged to include the complete removal of these rocks.

In the absence of adequate appropriations to enlarge the project for improvement, the alternative of forbidding the use of the rocks for commercial purposes, by inclosing them within restricted harbor lines, is imperative.

The wisdom of this action is confirmed by the written opinions, hereto appended, of the Board of Pilot Commissioners, New York City, and of the Chamber of Commerce, New York, whom the Board has consulted.

Attention is also invited to the accompanying report of Lieut. Col. G. L. Gillespie, Corps of Engineers, in charge of the improvement of East River, who presents to the Board special reasons why harbor lines should be drawn at this time around these rocks.

The Board recommends that the pierhead and bulkhead lines be made coincident, and be located at or near the existing high-water line in such a manner as to rectify the shore line in the most convenient manner.

The accompanying map,* upon which the recommended lines are delineated, sufficiently defines by offsets the location of the lines in regard both to the rocks and to the Government dike connecting them, and no additional description of them is required.

2. GRAVESEND BAY, EASTERN SHORE, FROM FORT HAMILTON TO CONEY ISLAND.

The legal lines on this shore were established by chapter 763, Laws of the State of New York, 1857.

When the New York Harbor Commission, acting under the authority of the State, recommended these lines for adoption by the State in 1856, there was but little development of the shore lands around Gravesend Bay, and it was understood that the recommended lines were provisional only.

As the bay is comparatively shoal, the pierhead and bulkhead lines east of the military lands at Fort Hamilton were made coincident, and were so located as to cross the bay on a curve which at the center of the bay was in 13 feet of water and 1,600 feet, approximately, from the shore line. A stone breakwater in Gravesend Bay, exterior to these lines, was suggested.

The legal lines adopted in 1857 were not described in detail by the act establishing them, and their location and direction are only made known by the chart upon which they were officially drawn.

The subject was again considered by the State Harbor Commission in 1875, at which time it was recommended that the bulkhead line of 1857 across the bay be retained, and that the pierhead line be pushed outwards a distance of 250 feet. As Norton Point had in the meanwhile grown to the westward, the Harbor Commission recommended new lines enveloping the point, situated to the westward of those adopted in 1857.

These recommended changes were never approved by any legislative act of the State.

The lines severally mentioned have been studied by the Board, and in view of important developments which have recently taken place around Gravesend Bay, and of the progressive advance of Norton Point towards the west, by accretions, a new set of lines delineated upon an accompanying chart* are submitted for approval and adoption.

The recommended lines may be described as follows:

1. *Bulkhead line.*—Starting at a point on the east side of Fort Hamilton avenue, where the bulkhead line approved by the Secretary of War March 4, 1890, terminates, the bulkhead line runs eastward along the legal bulkhead line of 1857 a distance of 1,822 feet to the east side of Battery Place, in the town of New Utrecht; thence in a straight line 5,180 feet to a point on the east side of Seventeenth avenue, extended westward, 740.5 feet west of west side of Cropsey avenue as now laid out

---

* Omitted.

or projected; thence eastward in a straight line 3,800 feet to a point in the center of Twenty-second avenue, extended westward, 798 feet from the west side of Cropsey avenue; thence east and south in a straight line 4,720 feet to a point on the north side of Bay Forty-ninth street, Gravesend, extended westward, 1,130 feet from west side of Harway avenue, and thence 1,300 feet south in a straight line to a point on the south side of Canal avenue on the north side of Gravesend Ship Canal as projected. Beginning again at a point where the east side of West Twenty-sixth street, extended northward, intersects the south side of Canal avenue, south of Gravesend Ship Canal, projected, the bulkhead line runs north in a straight line parallel to West Twenty-sixth street to an intersection with the south side, extended westward, of Canal avenue, north of the ship canal; thence westward parallel to Canal avenue 2,080 feet to opposite the east side of West Thirty-fourth street; thence northward at right angles 550 feet; thence westward, parallel to Canal avenue, 2,203 feet to a point nearly midway between Forty-second and Forty-third streets; thence westward on a curve drawn to a radius of 1,215 feet to the low-water line at the western end of Norton Point; thence southward on a curve drawn to a radius of 1,310 feet, around the point, beyond the low-water line, to nearly opposite West Forty-fourth street, extended southward across Norton Point, and eastward in front of the low-water line on the south shore of the point to a point on the west side of West Thirty-sixth street, extended southward, 1,100 feet south from the south side of Mermaid avenue.

2. Pierhead line.—The pierhead line begins at a point on the east side of Fort Hamilton avenue, extended southward, where the pierhead line approved by the Secretary of War March 4, 1890, terminates; runs thence eastward along the legal line of 1857 a distance of 600 feet, to a point nearly opposite the center of the Government reservation; thence on a curve drawn to a radius of 5,200 feet to a point a little westward of Seventh avenue extended, 640 feet from the high-water line; and thence, on tangents and curves drawn to different radii, following closely the line recommended by the State Harbor Commission of 1875, to near the north side of Norton Point, where the new line departs from the line of 1875; thence on a curve to the westward, drawn to a radius of 4,800 feet, to a point between Forty-fourth and Forty-fifth streets, extended northward, 200 feet to the northward of the high-water line; thence along the 18-foot curve, westward and southward, on a curve drawn to a radius of 1,675 feet, to a point near the 12-foot curve on south shore, opposite Forty-fourth street, extended southward, across Norton Point; and thence in a straight line 2,460 feet to a point in the water near the 12-foot curve, 1,722 feet south of the south side of Mermaid avenue, measured along the west side of West Thirty-sixth street.

3. SOUTH SHORE OF RARITAN AND SANDY HOOK BAYS, FROM CHEESEQUAKE CREEK TO HIGHLAND BRIDGE, ACROSS SHREWSBURY RIVER.

The legal lines along this shore, established by the Secretary of War June 19, 1890, terminate at Cheesequake Creek; to the eastward, extending as far as the Shrewsbury River, the legal lines were established by the riparian commissioners of New Jersey in 1878 and 1879.

The foreshore of the beach, for a distance of 4,000 feet out from the high-water line, is everywhere shoal until Atlantic Highlands are reached, at which locality the 13-foot curve of the bay is distant 2,500 feet, approximately, from the high-water line.

Following the principle adopted when locating similar lines on the opposite shore of Staten Island, the Board thinks that the bulkhead line should be kept well back to give a proper rectification only of the shore line, and that the pierhead line should be well advanced over the shoal water to make the piers conveniently available for commercial purposes.

The Board, therefore, recommends for approval and adoption the following harbor lines:

1. Bulkhead line.—The Board recommends that the existing legal bulkhead line from Cheesequake Creek to the Lorillard Pier, at or near the center of the bight between Conaskonk Point and Point Comfort, be adopted. Thence, to the eastward, the Board recommends that the bulkhead line be drawn closer inshore along a straight line 3,900 feet, to a point on the west side of Point Comfort, 600 feet north of the high-water line; that it run thence north of the general shore line 600 feet, approximately, from the high-water line to a point on the existing legal bulkhead line 3,500 feet to the eastward of Conover Beacon, and that it follow thence, along the legal line, to the terminus at Highland Bridge.

2. *Pierhead line.*—The Board recommends that from Cheesequake Creek, the eastern termination of the pierhead line established by the Secretary of War June 19, 1890, a pierhead line be drawn to Highland Bridge across Shrewsbury River, which shall follow without deviation the pierhead line established by the riparian commissioners of New Jersey in 1878 and 1879.

The legal lines along this shore were never described in detail by the riparian commissioners of New Jersey, by whom they were established. The location and direction of those now recommended may be readily determined by reference to the accompanying chart,* upon which linear dimensions are given at various points to represent distances between the lines, and between the lines and the shore, at high-water mark.

No further description of these lines is deemed necessary.

The Board repeats what has been stated in previous reports, that the "bulkhead line" defines the limit of solid filling and the "pierhead line" the limit to which open-piled structures may be built.

Supplementary maps* of Gravesend Bay, and of Raritan and Sandy Hook bays, not designed for publication, upon which the recommended lines are delineated in relation to the harbor lines previously suggested or established for those localities, are transmitted for the purpose of elucidating this report.

Respectfully submitted.

HENRY L. ABBOT,
Col. of Engineers, Bvt. Brig. Gen., U. S. A.
WM. P. CRAIGHILL,
Colonel of Engineers.
C. B. COMSTOCK,
Col. of Engineers, Bvt. Brig. Gen., U. S. A.
D. C. HOUSTON,
Colonel of Engineers.
G. L. GILLESPIE,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
February 13, 1892.

Respectfully submitted to the Secretary of War.

The Harbor Line Board for New York Harbor and its adjacent waters, constituted by Special Orders No. 49, Headquarters, Corps of Engineers, October 5, 1888, recommends for the approval of the Secretary of War the following harbor lines described in the within report and delineated upon the accompanying charts:

1. Great Mill and Little Mill rocks, East River.
2. Eastern shore of Gravesend Bay, from Fort Hamilton to Coney Island.
3. Southern shore of Raritan and Sandy Hook bays, from Cheesequake Creek to the highway bridge across Shrewsbury River at Navesink Highlands.

---

* Omitted.

It is recommended that the lines selected be approved, and that the Secretary place his approval both upon the report and the tracings submitted.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Second indorsement.]

Respectfully returned to the Chief of Engineers.

The harbor lines selected by the Board of Engineer Officers are approved.

S. B. ELKINS,
Secretary of War.

WAR DEPARTMENT, *March 9, 1892.*

LETTER OF THE BOARD OF COMMISSIONERS OF PILOTS, NEW YORK CITY.

OFFICE OF THE BOARD OF COMMISSIONERS OF PILOTS,
New York, December 22, 1891.

SIR: It has come to the knowledge of this Board that a movement is on foot to construct an island around Great and Little Mill rocks, which are claimed to be private property, thus preventing the full completion of the intended improvement in the navigable waters at Hell Gate, East River.

For many years it has been desired, and the expectation of the citizens of New York, that the work projected by the General Government and now in progress would render the gateway of the port by way of Long Island Sound and Hell Gate almost as safe and commodious as that by way of Sandy Hook.

Such a consummation is in every way desirable, not only in the interest of commerce, but also as an additional avenue of defense and supply in case of war, and in the opinion of this Board it would be a lamentable and disastrous ending of our hopes to permit a private claim, even were it far greater and more meritorious than the one now impending, to prevent the speedy and full completion of the work.

It would seem that private should yield to public interests, and that the projected public improvement should be fully carried out, the private owner being awarded a fair compensation for his property if his claim is found to be just.

This Board considers it necessary that all the obstructions at Hell Gate, including the Mill rocks, shall be removed, and respectfully urges this view upon the Harbor Line Board, especially as the success already obtained indicates that such a result may reasonably be hoped for.

Should, however, the removal of the Mill rocks be found to be impracticable, it is suggested that no encroachment upon the existing water space be permitted to be made beyond mean high-water line around said rocks.

By order of the Board.

Very respectfully,

AMBROSE SNOW,
President.

Gen. H. L. ABBOT, U. S. A.,
President U. S. Harbor Line Board.

LETTER FROM CHAMBER OF COMMERCE, NEW YORK.

CHAMBER OF COMMERCE OF THE STATE OF NEW YORK,
New York, January 18, 1892.

GENTLEMEN: I take pleasure in thus expressing to you what I have already said in person, viz, that this chamber is decidedly averse to any filling in of any of the spaces in any part of the passageway known as Hell Gate. The very great and important commerce which depends on that passage, and which constantly increases, demands not only that by no possibility shall that waterway be further impeded or contracted, but rather that every obstruction shall, as speedily as possible, be removed, however great or costly such work may prove to be.

Yours respectfully,

A. FOSTER HIGGINS,
Chairman of Committee on Harbor and Shipping.

THE BOARD OF U. S. ENGINEERS ON
HARBOR LINES FOR NEW YORK HARBOR.

REPORT OF LIEUTENANT-COLONEL G. L. GILLESPIE, CORPS OF ENGINEERS.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., November 10, 1891.

COLONEL: I have the honor to report that in my judgment the "preservation and protection" of the harbor of New York require that harbor lines be drawn around Great Mill and Little Mill rocks, Hell Gate, East River.

These rocks lie within the water space where the Harlem and East rivers unite, and any enlargement of the existing obstruction offered by them arising from the erection of bulkheads or piers exterior to the high-water line, would be most injurious to the channel through Hell Gate. The larger rock measures about one-half acre, and the smaller rock 200 square feet. Originally they were separated by a navigable channel 400 feet wide and 29 feet to 40 feet deep, but in 1880-'83 a riprap dike was built, at a cost of $8,600, by Gen. Newton, then in local charge of Government improvements, across the intervening space, for the purpose of better regulating the flow of the currents through the Gate, under general authority of Congress to improve the navigation of navigable waters.

The dike since construction has been used by the Government as a pier for the accommodation of Government vessels and storage of supplies used upon the work of construction.

In 1887, Mr. C. C. Higgins, who claimed the islands by purchase, and the land under water surrounding them and including the Government dike between them, by grant from the State dated January 20, 1885, began suit in the Ninth District Court, city of New York, to eject the Government representatives as trespassers, and to gain possession of the islands and dike for his own use.

The suit was decided April 29, 1889, in favor of the United States so far as the dike was concerned. It is understood that an appeal has been, or will be, taken from this decision.

On September 22, 1891, a deed was recorded in the register's office, New York City, for sale by Mr. Higgins to Mr. W. R. Peters, June 9, 1890, of all his right and title to these rocks and the attached water grant.

When harbor lines were recommended for East River in this vicinity by the Harbor Line Board of New York, September 17, 1890 (approved by the Assistant Secretary of War October 18, 1890), these rocks were considered too small in extent for consideration. But since it appears that private ownership in them, and in the dike connecting them, may be further contested, to the possible injury of the navigation of Hell Gate, it is deemed best that limiting harbor lines should now be drawn around the rocks to prevent their contingent occupancy for alleged purposes of commerce, and the erection of objectionable bulkheads or piers.

I respectfully request that the subject may be taken up and considered by the Harbor Line Board for New York Harbor and adjacent waters, to the end that harbor lines for the "preservation and protection" of the channel through Hell Gate may be submitted to the Secretary of War for his approval, in compliance with section 12 of the river and harbor act of September 19, 1890.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Lieut. Col. of Engineers.

Col. H. L. ABBOT,
CORPS OF ENGINEERS, U. S. A.,
President, New York Harbor Line Board.

---

b. MODIFICATION OF HARBOR LINES IN JERSEY FLATS, IN FRONT OF BAYONNE, NEW JERSEY, TO PERMIT SOLID FILLING AND CONSTRUCTIONS BY MR. R. G. PACKARD OUTSIDE THE ESTABLISHED HARBOR LINES.

NEW YORK, *August 22, 1891.*

SIR: The recently established harbor line, limiting solid filling on the New Jersey shore of New York Bay to the old State line of 1864, cuts off a part of my property which I had partly improved, and makes the piers about 6,000 feet long, its effects would be as follows:

1. I lose a large area on which I desired to erect buildings, to which I would have had rail and water connection, with safe and quiet water in which vessels could lie when receiving or discharging cargo.

2. All piers in this locality have less value than the solid fill would have. Vessels can not lie safely at these piers during northerly and easterly storms because of the swell made by these storms; in fact, the piers would be little used except in summer. I built several years ago 300 feet of pile wharf on the bay shore line at which it was impossible for vessels to lie in storms, until the basin surrounding it was inclosed by a breakwater. The piers will cost me more to build than the solid fill and, when built, are perishable, requiring frequent costly repairs and renewals.

At the date of your order prohibiting work outside of the line as now laid, a bulkhead had been partly completed on the line of 1883 and a fill made at that point above high water and from that point to the shore. the fill was partly above and partly below high water, but all nearly to high water. My plans include a channel inshore, and interior basins, whose area back of the approved line will be nearly 40 acres.

When the Harbor Board were in session here I stated these facts and asked that they recommend to you that I should be permitted to fill an area outside of the harbor line, proportional to the tidal basin area left by me inside that line.

Such permission has been granted to property owners on the Brooklyn shore.

I now request that permission be given me to make a fill outside of the established harbor line on the condition that I shall retain a like basin area back of that line.

Respectfully,

R. G. PACKARD.

Hon. REDFIELD PROCTOR,
Secretary of War.

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
August 25, 1891.

Respectfully referred to the President of the New York Harbor Line Board for report.

To be returned.

H. M. ADAMS,
Major, Corps of Engineers, in Charge.

[Third indorsement.]

NEW YORK HARBOR LINE BOARD,
New York City, October 13, 1891.

Respectfully returned to the Chief of Engineers, inclosing two letters* from Mr. Packard, dated September 5 and 18, 1891, respectively, with two explanatory maps* accompanying the same.

Col. Gillespie, on behalf of the Board, has caused a survey to be made showing the present condition of Mr. Packard's channel and its artificial banks exterior to the bulkhead line approved by the Secretary of War August 19, 1891, so far as work has been done thereon. A blue print* is appended.

Mr. Packard's case is different from any other that is likely to arise in this vicinity in that he proposes to supply a tidal prism in rear of the legal bulkhead line equivalent to that which he desires to sacrifice in front; also in the fact that while the work was authorized by law he began, in furtherance of an important public improvement for the benefit of Bayonne as well as himself, the construction of embankments outside of what is now the legal bulkhead line. Moreover, he claims that a solid filling in this vicinity will act like a breakwater, and thus be beneficial not only to his own channel but also to any pile structures which may be erected on adjacent property, without which protection vessels lying at the wharves would be subject to injury during storms.

---

* Not printed.

After considering the subject in all its bearings the Board sees no objection on the part of the United States to the approval of the plans proposed by Mr. Packard to build his solid piers exterior to the approved bulkhead line, provided he will guarantee to the satisfaction of the Secretary of War to maintain an equal tidal prism behind the said line; also provided that he will revet, in the manner proposed in his letter of September 18, 1891, and accompanying drawings, the whole north side of the channel to its extreme outward terminus, and the south side of the channel to the intersection of the bulkhead line of 1883; and further provided that the extension between the point last named and the proposed outer terminus be revetted by light cribs or by close piling; and that the reverse sides of all solid filling exterior to the bulkhead line approved by the Secretary of War be protected against wash by substantial stone riprap; and that the work be executed under the supervision of the United States local engineer.

For the Board:

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.,
President of the Board.

[Fourth indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
October 16, 1891.

Respectfully returned to the Secretary of War.

Mr. Packard asks permission to make a solid filling outside of the established bulkhead line on Jersey Flats, New York Bay.

This application was referred to the New York Harbor Line Board, and its report is contained in the third indorsement.

I concur in the views of the Board, and recommend that the authority desired by Mr. Packard be granted, subject to the conditions and terms recommended by the Board.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Fifth indorsement.]

WAR DEPARTMENT, *October 17, 1891.*

Respectfully returned to the Chief of Engineers.

Let approval of the authority desired be prepared with great care, covering all the conditions named in the third indorsement hereon.

By order of the Acting Secretary of War:

SAM'L HODGKINS,
Acting Chief Clerk.

[Sixth indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
October 17, 1891.

Respectfully returned to the Secretary of War, with form of approval as directed.

The first condition of approval requires Mr. Packard to guarantee to the satisfaction of the Secretary of War to maintain behind the approved bulkhead line a tidal prism equal in volume to the fill produced by the proposed piers exterior to the bulkhead line.

It is recommended that Mr. Packard be notified to file such guarantee.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Seventh indorsement.]

WAR DEPARTMENT, *October 21, 1891.*

Respectfully returned to the Chief of Engineers.

Let the plans and permission be forwarded for acceptance by Mr. Packard and let a bond also be forwarded for execution; the condition to be for the maintenance of a tidal prism in the rear of the bulkhead line equal to the fill (or equal to the displacement of the fill) to be made in front of it. The bond to be approved by the New York Harbor Line Board and by the Chief of Engineers.

By order of the Assistant Secretary of War:

JOHN TWEEDALE,
Chief Clerk.

[Eighth indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
October 21, 1891.

Respectfully returned to the Board of Engineers, inviting attention to the foregoing indorsements.

It is requested that the Board have the instrument accepted by Mr. Packard where indicated on the form herewith, and when he has executed the accompanying bond, the papers will be returned by the Board in accordance with instructions in seventh indorsement.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Ninth indorsement.]

WAR DEPARTMENT, *November 24, 1891.*

Respectfully returned to the Chief of Engineers, with the suggestion that the bond would be satisfactory if the conditions of the original draft are changed as follows: Change the word "maintain" to "construct," and add at the end of the paragraph containing the condition the following words, "and shall not fill or impair it, or permit it to be filled or impaired by his act or neglect or by anyone claiming under or through him." The change indicated has been made in the copy of the bond herewith. This change would seem to obviate the objection made by Mr. Packard's attorney, and at the same time provide for all the Government's wants.

L. A. GRANT,
Acting Secretary of War.

[Tenth indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
November 27, 1891.

Respectfully returned to the Board of Engineers, attention being invited to the seventh and ninth indorsements hereon.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Eleventh indorsement.]

NEW YORK HARBOR LINE BOARD,
New York City, December 16, 1891.

Respectfully returned to the Chief of Engineers, with the directions to this Board as contained in these papers complied with. Attention, however, is invited to the vacant date on the first page of the bonds in duplicate, which can only be filled in after the Secretary of War has signed the authorization. Mr. Packard has officially stated to me, in the presence of Col. Gillespie, that he has no objection to this date being supplied.

For the Board:

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen.,
U. S. A., President of the Board.

[Twelfth indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
December 19, 1891.

Respectfully returned to the Acting Secretary of War.

The conditions of the proposed permit have been accepted by Mr. Packard and the bond has been executed. If this permit is signed by the Secretary of War, Mr. Packard will be authorized to extend solid piers about 5,000 feet beyond the bulkhead line into New York Harbor, as shown on the harbor line chart* herewith.

Whether this authority will permit Mr. Packard to encroach on the rights of other riparian owners is submitted for consideration before final approval.

The proposed piers extend in a curved line in front of Constable Point. In view of all the facts and after full consideration given to the case, I desire to withdraw my recommendation dated October 16, 1891, until it can be shown that the contiguous and neighboring riparian owners to Mr. Packard have no rights invaded by Mr. Packard's constructions.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Thirteenth indorsement.]

WAR DEPARTMENT,
JUDGE-ADVOCATE-GENERAL'S OFFICE,
Washington, D. C., December 24, 1891.

Respectfully returned to the Secretary of War, inviting attention to the fourth and twelfth indorsements hereon for a statement of the case.

Under section 7 of the act of September 19, 1890, the Secretary of War may permit building of wharves, piers, dolphins, booms, dams, weirs, breakwaters, bulkheads, jetties, or structures of any kind outside established harbor lines, and under section 12 of the same act he may prescribe regulations from time to time to govern or regulate the matter of constructing and maintaining these structures.

---

*Omitted.

This permission of the Secretary of War and the regulations prescribed by him have reference to public navigation rights alone; that is, the obtaining the one and compliance with the other only protect the party from the penalties, etc., prescribed by the acts of Congress, and do not in any sense affect the rights of owners of the soil at the bottom of the water in cases where there is such an ownership, or the rights of riparian or literal owners, to wharf out, or to have access to the water in front of their lands. After permission given by the Secretary of War these owners, if their individual rights were infringed, would have their usual remedies, the permission affecting only the rights of the public. Yet this might not be known to the parties concerned, and they, therefore, might misconstrue the action of the Secretary of War in granting the permission. And I therefore, recommend that before Mr. Packard's request be granted he be required to show that he is entitled, so far as individual rights are concerned, to construct the work he is proposing to build.

G. Norman Lieber,
Acting Judge-Advocate-General.

War Department, *December 26, 1891.*

Respectfully returned to the Chief of Engineers.

Inasmuch as Mr. Packard has been given to understand that the Department would consent to the improvement proposed by him upon certain conditions, and inasmuch as he has furnished the bond required, I do not think the Department can now in good faith withhold its consent.

And inasmuch as the War Department does not assume to interfere in the least with private rights, and can not convey them, it would be manifestly improper to undertake to decide upon Mr. Packard's and others' relative rights.

The authority heretofore recommended and practically agreed upon is now given. Let the vacant date in the bonds be supplied in accordance with the agreement mentioned in the eleventh indorsement.

L. A. Grant,
Acting Secretary of War.

---

c. MODIFICATION OF HARBOR LINES ESTABLISHED JANUARY 9, 1891,* ON THE NORTH SHORE OF EAST RIVER BETWEEN OAK POINT AND HUNTS POINT.

Harbor Line Board,
New York City, May 20, 1892.

General: The Harbor Line Board for New York Harbor and adjacent waters, constituted by Special Orders No. 49, Headquarters Corps of Engineers, October 5, 1888, has had under consideration the application of the East Bay Land and Improvement Company of New York for a modification of the bulkhead and pierhead lines between Oak Point and Hunts Point, on the north shore of East River, as established by the Secretary of War under date of January 9, 1891.* This application was forwarded for remark by your indorsement of May [April] 21, 1892, and the Board has now the honor to submit the following report thereon:

---

* See Annual Report, Chief of Engineers, 1891, page 963.

An examination and survey of the locality has been made by Lieut. Col. Gillespie since the receipt of the papers, and a tracing of the map[*] accompanies this report, with the established harbor lines shown in black and a modification now proposed by the Board, shown in red. A public hearing was given by the Board to the parties in interest on this date.

It will be seen from the map that no encroachment upon the narrow part of the channel is recommended, but that the proposed extension is restricted to indentations in the shore where the rocky character of the bottom would render the excavation of docks expensive and difficult. The site is a valuable one for commercial purposes, the extension of the bulkhead line is in very shallow water, and it is believed that the modifications may be granted without prejudice to the preservation and protection of the harbor. The following is a definition of the new lines proposed:

DESCRIPTION.

The modified *pierhead* line begins at the point where the pier and bulkhead lines, as approved by the Secretary of War, January 9, 1891, diverge, which point is in the southerly prolongation of the east side of Poillon street, 285 feet from the north side of Edgewater Road; running thence easterly in a straight line to a point 740 feet south of the south side of Conover avenue, and 55 feet east of the east side of Spofford street; thence easterly in a straight line to a point in the pierhead line approved by the Secretary of War January 9, 1891, 982 feet from the south side of Foote avenue and 21 feet west of the west side of Barretto street.

The modified *bulkhead* line begins at a point in the bulkhead line approved by the Secretary of War January 9, 1891, 207 feet south of the north side of Edgewater Road and 27 feet east of the east side of Arnold street; runs thence easterly in a straight line to a point 317 feet south of the south side of Conover avenue and 37 feet east of the east side of Craven street; thence in a straight line to a point 300 feet south of the south side of Coster avenue 8 feet west of the east side of Casanova street; thence eastward in a straight line to a point in the modified pierhead line 707 feet south of the south side of Foote avenue 40 feet west of the west side of Tiffany street; thence easterly, coinciding with the modified pierhead line, 400 feet, and thence a farther distance of 240 feet along the approved pierhead line; thence the bulkhead line diverges from the pierhead line and runs northerly in a straight line at right angles to the pierhead line 200 feet; thence easterly in a straight line at right angles 270 feet; thence northerly in a straight line at right angles 300 feet; thence easterly in a straight line at right angles 20 feet to a point in the bulkhead line approved by the Secretary of War January 9, 1891; thence easterly along said approved bulkhead line 1,480 feet, and in the prolongation of said approved bulkhead line a farther distance of 230 feet; thence southerly in a straight line at right angles 230 feet; thence easterly in a straight line at right angles 350 feet; thence southerly in a straight line at right angles 180 feet; thence easterly in a straight line at right angles 420 feet to near the eastern edge of crib at Hunts Point; thence northeasterly in a straight line parallel to the pierhead line on the Bronx River side and 270 feet northerly therefrom 410 feet, and thence northwesterly in a straight line at right angles until it intersects the bulkhead line approved by the Secretary of War January 9, 1891.

Respectfully submitted.

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.
WM. P. CRAIGHILL,
Colonel of Engineers.
C. B. COMSTOCK,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.
D. C. HOUSTON,
Colonel of Engineers.
G. L. GILLESPIE,
Lieutenant-Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

---

[*] Omitted.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
June 7, 1892.

Respectfully submitted to the Secretary of War.

The Harbot Line Board for New York Harbor and adjacent waters has had under consideration application of the East Bay Land and Improvement Company for modification of bulkhead and pierhead lines between Oak Point and Hunts Point on the north shore of East River, as established by the Secretary of War January 9, 1891.

The Board proposes certain modifications of the lines already established as shown on accompanying tracing, and states that it is believed the modifications may be granted without prejudice to the preservation and protection of the harbor.

It is recommended that the modifications proposed by the Board be approved, and that the Secretary place his approval both upon this paper and upon the accompanying tracing.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

WAR DEPARTMENT, *June 11, 1892.*

Approved.

L. A. GRANT,
Acting Secretary of War

d. MODIFICATION OF PIERHEAD LINE ESTABLISHED MARCH 4, 1890,[*] ON THE ARTHUR KILL, IN FRONT OF PERTH AMBOY, NEW JERSEY.

HARBOR LINE BOARD,
New York City, May 20, 1892.

GENERAL: The Harbor Line Board for New York Harbor and adjacent waters, constituted by Special Orders No. 49, Headquarters, Corps of Engineers, October 5, 1888, has had under consideration the application of Hugh Ramsay and others for a modification of the bulkhead and pierhead lines on the Arthur Kill, in front of Perth Amboy, as established by the Secretary of War under date of March 4, 1890. The papers in this case were forwarded for the action of the Board by your indorsement of December 24, 1891. The recommendation of the Board, dated January 18, 1892, that a survey should be made at the locality in question was approved by you, and it was made, under the direction of Lieut. Col. Gillespie, in season to be brought before the Board at its meeting of this date. Due notice had been given to the general public and the parties in interest, and they appeared and presented their views upon the subject at a public hearing to-day.

After duly considering the matter, the Board can not recommend any change in the bulkhead lines as already established by the Secretary of War, but it does favor the moderate extension of the pierhead line as set forth below. Such an extension is not opposed by the towing interest on the Arthur Kill, and will not injuriously affect the flow of the tidal current; the extension thus granted will be a material benefit to the riparian owners.

---

[*] See Annual Report, Chief of Engineers, 1890, page 796.

The following is a definition of the new pierhead line proposed, the accompanying map* showing its location in red, the established pierhead and bulkhead lines being shown in black.

DESCRIPTION.

Beginning at a point in the pierhead line approved by the Secretary of War March 4, 1890, 254 feet north of the north side of Smith street and 318 feet east of the east side of Water street, the modified pierhead line runs in a straight line to the northeast corner of the Arthur Buell Manufacturing Company's Dock, 104 feet north of the north side of Buckingham avenue, and 1,120 feet east of the east side of High street; runs thence in a straight line to the southeast corner of the northerly pier of the Lehigh Valley Railroad Company's coal terminus; thence in a straight line 469 feet tangent to the curve in the pierhead line around Plowshare Point, established by the Secretary of War March 4, 1890.

Respectfully submitted,

HENRY L. ABBOT,
Col. of Engineers, Bvt. Brig. Gen., U. S. A.
WM. P. CRAIGHILL,
Colonel of Engineers.
D. C. HOUSTON,
Colonel of Engineers.
G. L. GILLESPIE,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
July 15, 1892.

Respectfully submitted to the Secretary of War.

The Board of Engineers on harbor lines of New York Harbor and adjacent waters has had under consideration application of Hugh Ramsay and others for modification of bulkhead and pierhead lines on Arthur Kill, in front of Perth Amboy, as established by the Secretary of War March 4, 1890.

After duly considering the matter the Board states that it cannot recommend any change in the bulkhead lines already established, but it does favor the moderate extension of the pierhead line, as within described and shown on the accompanying tracing.

It is recommended that the modification of the pierhead line proposed by the Board be approved, and that the Secretary place his approval both upon this report and the accompanying tracing.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Second indorsement.]

WAR DEPARTMENT, *August 9, 1892.*

Approved.

L. A. GRANT,
Acting Secretary of War.

---

*Omitted.

APPENDIX F.

IMPROVEMENT OF RIVERS AND HARBORS ON SOUTHWESTERN SHORE OF LONG ISLAND AND NEAR STATEN ISLAND, NEW YORK, AND IN NORTHEASTERN NEW JERSEY.

REPORT OF CAPTAIN THOS. L. CASEY, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Sumpawanus Inlet, New York.
2. Canarsie Bay, New York.
3. Sheepshead Bay, New York.
4. Arthur Kill, New York and New Jersey.
5. Channel between Staten Island and New Jersey.
6. Passaic River, New Jersey.
7. Elizabeth River, New Jersey.
8. Rahway River, New Jersey.
9. Raritan River, New Jersey.
10. South River, New Jersey.
11. Keyport Harbor, New Jersey.
12. Mattawan Creek, New Jersey.
13. Shoal Harbor and Compton Creek, New Jersey.
14. Shrewsbury River, New Jersey.
15. Manasquan (Squan) River, New Jersey.

UNITED STATES ENGINEER OFFICE,
New York, July 8, 1892.

GENERAL: I have the honor to transmit herewith my annual report on the works of river and harbor improvement in my charge for the fiscal year ending June 30, 1892.

Very respectfully, your obedient servant,

THOS. L. CASEY,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

F 1.

IMPROVEMENT OF SUMPAWANUS INLET, NEW YORK.

Sumpawanus Inlet, known in the neighborhood and on the Coast Survey charts as Sumpawams Creek, is a small creek on the south side of Long Island, emptying into the Great South Bay. It lies about 36 miles east of New York City, 15 miles east of the western end of Great South Bay, and nearly twice as far from its eastern end.

Fire Island Inlet, through which most of the waters of Great South Bay pass into the Atlantic Ocean, lies south-southeast of Sumpawams Creek, distance about 6 miles in a direct line, but 11 miles by the channel. The inlet is a tidal stream from 100 to 200 feet wide, running up to the town of Babylon, Long Island, which lies less than a mile north of the mouth. It is crossed here by a dam, which forms a reservoir for the fresh water of a small creek which supplies the town with water. The mean rise and fall of the tides at the mouth of the inlet is only 1.3 feet, and the bottom of the bay and of the inlet is soft mud.

The first survey of Sumpawams Creek of which we have any record was ordered by act of Congress, approved June 14, 1880, and was made during the fall of 1881, under the direction of Gen. (then Col.) John Newton, Corps of Engineers. His report may be found in the Annual Report of the Chief of Engineers for 1881, Part I, page 653.

The project of improvement, based upon this survey, provided for dredging a channel 150 feet wide and 5 feet deep at mean low water from the 5-foot curve in the bay to the steamboat dock at the mouth of the creek, a distance of about 1,500 feet, and thence 5 feet deep and 100 feet wide up the inlet to the town of Babylon, a distance of about 3,500 feet farther. The estimated cost of making this improvement was $23,115.

The mean range of the tides at the mouth of the inlet being only 1.3 feet, there was practically no current swift enough to produce scour. The depth of water in the proposed channel, at the time of the survey, was from 1 to 3 feet in the creek and from 3 to 5 feet outside. It was not believed that diking would assist in improving this entrance, and inquiry showed that the depth of water both outside and inside the inlet had materially diminished in late years.

The amount expended under the project to June 30, 1891, was $7,000, giving a channel 75 feet wide and 5 feet deep from the steamboat wharf to a point 750 feet below it, besides two cuts, each 25 feet wide, alongside the wharf. Outside of the cut so made and extending to the 5-foot curve in the bay a shoal was left on which the depth was only about 4¾ feet.

An examination made in 1886 showed that since the last dredging was done, in 1883, both the cut and the flat outside had shoaled from 6 inches to 1 foot, the depth in the cut being about 5 feet, while on the flat it was from 4 to 4½ feet. This was to have been anticipated, as appears by the preliminary report made by Gen. Newton. The 5-foot curve in the bay was 1,500 feet from the steamboat wharf, but inside this curve, for about 750 feet towards the wharf, lay the flat.

The commerce of Sumpawams Creek is essentially that of Babylon, a small town of from 3,000 to 5,000 inhabitants 1 mile above the mouth of the creek, depending almost entirely upon summer trade of the hotels and the cottages along the north shore of Great South Bay and on Fire Island Beach.

The commerce of Babylon by water has been decreasing, apparently, because the Long Island Railroad has taken away the seagoing business. Babylon itself has improved and has become a fashionable summer resort. At present its commerce by sea is carried on by three passenger steamboats drawing from 4 to 5 feet, running in summer to Fire Island Beach; three schooners, drawing from 5 to 5½ feet, carrying brick, lime, lumber, and other heavy freight to Babylon the year round; one hundred sloops and pleasure boats, drawing from 1 to 2 feet of water, taking out sailing and fishing parties in summer, of which seven or eight remain in use during the winter fishing and taking oysters and clams to Patchogue, Sayville, and New York.

The commerce of the creek, in my judgment, does not warrant the formation of a channel more than 5 feet deep from the 5-foot curve in the bay to the steamboat wharf for the convenience of the few steamers and schooners which make use of the creek.

It is stated that the shoals in the bay kill the sea so entirely that pleasure boats can now lie in the mouth of the creek in all weather.

So far as the extension of the improvement from the steamboat dock up to the inlet is concerned there appears to be no reason why the Government of the United States should undertake it.

The original estimate of the cost of the work was $23,115. Seven thousand dollars have been appropriated.

Ten thousand dollars can be expended in giving a 5-foot channel out into the bay for the use of steamboats, but I think that the work is more a matter of local than public interest.

This work is in the collection district of New York, which is the nearest port of entry. Nearest light-house, Fire Island Light. Nearest fort, Fort Hamilton.

The amount of revenue collected at the port of New York during the fiscal year ending June 30, 1892, was $120,732,613.89.

Original estimate	$23,115

AMOUNTS APPROPRIATED.

By act of Congress approved—	
March 3, 1881	$5,000
August 2, 1882	2,000
Total	7,000
Amount expended	7,000

Money statement.

Amount (estimated) required for completion of existing project	$16,115.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Sumpawanus Inlet, New York, during the past year, were kindly furnished by the Hon. James B. Cooper, justice of the peace, Babylon, Long Island.

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Oysters and clams	50	$20,000	Steam	10	4½	90
Fish	160	19,000	Sail	380	3	10
Building material	1,200	10,000				
Miscellaneous	17	1,700				
Total	1,427	50,700		390		

The above table shows an increase of 129 tons over that reported for the year ending December 31, 1890.

F 2.

IMPROVEMENT OF CANARSIE BAY, NEW YORK.

The first survey of this bay with a view to its improvement was made in 1879. The scheme of improvement involved a channel 6 feet deep at mean low water and 100 to 150 feet wide, extending from the shore at Canarsie Landing to the navigable channel in Jamaica Bay, a distance of about 3,500 feet. It was thought that the channel might be maintained by the construction of two pile dikes, forming a tidal reservoir. The estimated cost under this project was $88,000. A history of the work in considerable detail is given in the Annual Report of the Chief of Engineers for 1887, Part I, page 637.

The total amount expended upon this work up to June 30, 1891, was $42,688.36, with which two pile dikes had been built on the north and south sides of the channel at its entrance into Jamaica Bay, 1,058 and 820 feet in length, respectively, and the channel dredged to a depth of 6 feet at mean low water, with widths of 50 to 125 feet, from Canarsie Landing to the deep water of the bay. In addition to this several other improvements, not contemplated in the main project, but which added materially to the facility of navigation or to the maintenance of the channel, had been executed, viz, the excavation of a cut 100 feet long and 50 feet wide, with a depth of 6 feet, on the east side of the steamboat landing at Canarsie, and a cut at the end of the wharf at Canarsie Landing extending through to the southwest to connect with the southwest channel, the latter for the purpose of promoting tidal circulation. The tidal currents are due to a mean rise and fall of 4.7 feet.

Under the contract with Elijah Brainard, alluded to in my last Report and dated March 20, 1891, for the removal of about 13,000 cubic yards of material at 24½ cents per cubic yard, operations were begun August 20, 1891, and concluded September 19, 1891, the amount removed having been 12,760 cubic yards. This work resulted in an increase of the channel width of 50 feet for a distance of 1,950 feet from the landing at Canarsie, one cut being dredged from each side. Two cuts were also taken from the south side of the channel, extending for a distance of 600 feet from the outer end of the north dike, and a single cut 180 feet in length along the side of the dock at Canarsie Landing. The main channel has now, therefore, a width of 100 to 150 feet from Canarsie Landing to the deep water of Jamaica Bay, with a minimum depth of 6 feet at mean low water.

Authority was granted by the Chief of Engineers on November 20, 1891, to make some necessary repairs on the North Dike by hired labor and the purchase of materials in open market, as being most economical and advantageous to the Government under existing conditions. Work was begun December 11, 1891, and the repairs completed January 11, 1892, at a total cost of $1,100.25. These dikes, although perhaps not essential to the maintenance of the channel, seem to be of sufficient benefit as a protection for the entrance against floating ice to warrant their repair from time to time.

The expenditures during the past fiscal year amount to $5,255.77, as follows:

Dredging under contract	$3,126.20
Repairs of dike	1,100.25
Inspection	354.17
Drafting	175.00
Administration	500.15
Total	5,255.77

Canarsie Landing, besides being the terminus of the Brooklyn, Rockaway Beach and Jamaica Bay Railroad, from which passengers are transshipped by steamer to Rockaway Beach, has a large fishing industry.

It is thought that $10,000 will be sufficient to complete the channel and keep the dikes in repair, and an appropriation of this amount is therefore recommended.

This work is in the collection district of New York, which is the nearest port of entry. Nearest light-house, Fort Tompkins Light. Nearest fort, Fort Hamilton.

The amount of revenue collected at the port of New York during the fiscal year ending June 30, 1892, is $120,732,613.89.

AMOUNTS APPROPRIATED.

By act of Congress, approved—	
June 14, 1880	$10,000.00
March 3, 1881	5,000.00
August 2, 1882	3,000.00
July 5, 1884	5,000.00
August 5, 1886	10,000.00
August 11, 1888	10,000.00
September 19, 1890	5,000.00
Total	48,000.00
Amount expended	47,944.13

Money statement.

July 1, 1891, balance unexpended	$5,311.64
June 30, 1892, amount expended during fiscal year	5,255.77
July 1, 1892, balance unexpended	55.87
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ended June 30, 1893	5,055.87
Amount (estimated) required for completion of existing project	35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Canarsie Bay, New York, during the year ending December 31, 1891, were kindly furnished by Mr. William Warner, superintendent of the Brooklyn, Rockaway Beach and Jamaica Bay Railroad:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Fish	2,300	$150,700	Steam	5	5½	300
Coal	3,160	13,000	Sail	70	5½	15
Fertilizers	35,000	33,000	Yachts	90	3½	3
Oysters and clams	15,750	301,000				
Total	56,210	497,700		165		

The above table shows an increase in the commerce of 5,412 tons over that reported for the year ending December 31, 1890.

F 3.

IMPROVEMENT OF SHEEPSHEAD BAY, NEW YORK.

Sheepshead Bay, Long Island, is a small tidal bay about 2 miles long, lying inside Coney Island, New York, and extending easterly from the village of Gravesend to Rockaway Inlet, into which it empties. Its width varies from 100 to 1,000 feet, and its depth from 0 to 10 feet at mean low water. The natural entrance is subject to progressive changes of position, due to the action of the waves on the sandy beaches.

The first survey, with a view to its improvement, of which we have any record, was made in 1879, by General Newton, whose report, dated February 7, 1879, may be found in the Annual Report of the Chief of Engineers for 1879, page 400. The plan of improvement proposed, which was based upon this survey, provided for diking the channel and connecting it with Rockaway Inlet, the estimated cost being $100,000.

A survey, made in 1882, furnished data for two revised estimates of the cost, providing for an outlet from Sheepshead Bay into Dead Horse Inlet instead of directly into Rockaway Inlet, as at first proposed. The first of these estimates, which included a system of dikes in addition to dredging, was given as $62,900; the second, omitting the dikes, as $34,200. Detailed statements of these estimates were given in my report for 1890, page 838. The second of these plans is the one that was adopted for the work.

The original project for the formation and maintenance of a dredged channel, 100 feet wide and 6 feet deep, mean low water, was modified in February, 1889, the modified project contemplating a channel 5,350 feet long, 60 feet wide, and 5½ feet deep, mean low water, from the town of Sheepshead to within 1,080 feet of Dead Horse Inlet Cut, to connect with the channel of similar width and depth already existing at that point.

Under this project 27,025 cubic yards were dredged by Mr. M. H. Flannery, by private agreement, at 25 cents per cubic yard, measured in scows, giving a channel of the required width and depth 3,400 feet in length, extending from the town of Sheepshead toward the cut at Dead Horse Inlet. This channel, which was completed December 6, 1889, seems to have maintained itself in a very satisfactory manner.

Sheepshead Bay is a harbor of minor importance, and must so continue until the entrance can be improved by an expensive system of jetties. At present it is for the most part used as a haven for small oyster and clam boats and for a large fleet of pleasure boats in the summer season. The utility of future appropriations must be judged of, therefore, by these facts.

The commerce of the bay was reported for the year 1890 to be 106,600 tons, valued at $2,380,000.

The expenditures for the fiscal year ending June 30, 1892, amount to $43.17 for office expenses.

This work is in the collection district of New York, which is the nearest port of entry. Nearest light-house, Fort Tompkins Light; nearest fort, Fort Hamilton.

The amount of revenue collected at the port of New York during the fiscal year ending June 30, 1892, is $120,732,613.89.

Original estimate (1879)	$100,000
Revised estimate (1882)	34,200

AMOUNTS APPROPRIATED.

By act of Congress approved—	
June 14, 1880	$3,000.00
March 3, 1881	5,000.00
August 2, 1882	3,000.00
July 5, 1884	5,000.00
August 5, 1886	5,000.00
August 11, 1888	5,000.00
Total	26,000.00
Amount expended	25,827.43

Money statement.

July 1, 1891, balance unexpended	$215.74
June 30, 1892, amount expended during fiscal year	43.17
July 1, 1892, balance unexpended	172.57
Amount (estimated) required for completion of existing project Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	8,200.00

F 4.

IMPROVEMENT OF ARTHUR KILL, NEW YORK AND NEW JERSEY.

A history of this improvement, which originated by special resolution of the Committee of Commerce in the Senate, is given in the Annual Report of the Chief of Engineers for 1889, Part I, page 819, and a further statement of the condemnation proceedings necessary for the acquirement of the land forming Steep Point is given in my Annual Report for 1890, page 843.

The total amount expended upon this improvement to June 30, 1891, was $10,340.59, with which amount payments had been made in the condemnation proceedings alluded to above, in the part purchase of the Government tug at present on the Raritan River, in dredging off about one-half an acre of the obstruction known as Steep Point, with a resulting increase of 150 feet in the channel width and with a uniform depth of 13 feet at mean low water where the land was originally 6 feet above that plane, and in certain administrative expenses of the office.

The available funds appropriated by the act of September 19, 1890, were covered by a contract made with the Atlantic Dredging Company, dated March 21, 1891, which was completed June 25, 1891, as stated in my last annual report. This work resulted in an additional channel width of 60 feet, with the same mean low-water depth as stated in the preceding paragraph, and another half acre of land was removed, making a total of about one acre removed under the project, and giving a total channel width at this point of 710 feet. No work has been done during the past fiscal year.

An examination of the map accompanying my annual report for 1890 will show that the result anticipated by the removal of the point is already felt to a marked degree. The flood threads, as indicated by the heavy lines, are, in the neighborhood of the point, more nearly in a direction perpendicular to the Baltimore and Ohio Railroad bridge than those indicated by the earlier survey, which are in dotted lines.

It is desirable that a further appropriation of $9,500 be made for the fiscal year ending June 30, 1894, as there are no funds in hand with which to complete the improvement, and the favorable results thus far attained seem to warrant the ultimate completion of the project.

The expenditures for the fiscal year ending June 30, 1892, amount to $5,905, as follows:

Dredging under contract	$5,390
Inspection	100
Drafting	75
Administration	340
Total	5,905

This work is in the collection district of New York, which is the nearest port of entry; nearest light-house, Bergen Point Light; nearest fort, Fort Tompkins.

Amount of revenue collected at the port of New York during the fiscal year ending June 30, 1892, is $120,732,613.89.

AMOUNTS APPROPRIATED.

By act of Congress approved—	
August 11, 1888	$10,000.00
September 19, 1890	7,000.00
Total	17,000.00
Amount expended	16,245.59

Money statement.

July 1, 1891, balance unexpended	$6,659.41
June 30, 1892, amount expended during fiscal year	5,905.00
July 1, 1892, balance unexpended	754.41
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,754.41
Amount (estimated) required for completion of existing project	4,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	4,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Arthur Kill, New York and New Jersey, during the year ending December 31, 1891, were compiled from statements furnished by parties making shipments over this water way:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Coal	4,790,333	$17,212,521	Steam	4,042	11	456
Building material	811,367	2,790,851	Sail	4,912	10	394
Iron and ores	74,102	2,342,401	Barges	18,119	10½	424
Miscellaneous	1,271,833	64,673,166	Rafts	6,810		
Total	6,947,635	87,018,939		33,883		

The above table shows an increase in the commerce of 2,031 tons over that reported for the year ending December 31, 1890.

F 5.

IMPROVEMENT OF CHANNEL BETWEEN STATEN ISLAND AND NEW JERSEY.

A description of this channel and a complete history of the work done toward its improvement may be found in the Annual Report of the Chief of Engineers for 1887, Part I, page 743.

Thus far the improvement has been confined to that part of the channel, about 1¾ miles long, which lies to the east of Elizabethport, N. J., and at the mouth of Newark Bay. This originally had a depth of only 9½ feet at mean low water, while the remainder, lying between the shores of Staten Island and New Jersey, had a depth of from 14 to 40 feet at mean low water.

The first project for the improvement of this channel was made in 1873. This provided for dredging it to a depth of 16 feet for a width of 150 feet at its shallowest part, and protecting the cut by parallel dikes. The estimated cost of this was $443,210. Fifty thousand dollars of this amount appropriated in 1874, was spent in 1874–'75 in the construction of 2,237 feet of the south dike, opposite Elizabethport.

Great opposition being made to this plan by oyster men and towboat men, it was decided to modify it, and the project was therefore changed in 1880 so as to dredge a channel 400 feet wide and 13 feet deep over the middle 200 feet of its width, leaving it but 12 feet deep over the remaining widths of 100 feet on each side. The estimated cost of this work was $125,705. In addition to this it was proposed, should it be found necessary, to build four detached dikes along the line of the channel, two on the north and two on the south side, the estimated cost of which was $60,000, bringing the total estimated cost of the proposed improvement up to $185,705. This estimate was, in 1883, further increased to $210,000, by Maj. (now Lieut. Col.) Gillespie, at that time officer in charge of the improvement. A modification of the project, having in view the total rejection of the dikes, was submitted May 9, 1889, and was approved May 15.

A further modification of the original project, necessitated by the increasing demands of commerce, and the one under which the present appropriation is being expended, was approved October 20, 1890. This project calls for a uniform channel depth of 14 feet at mean low water over the entire width of 400 feet.

The amount expended upon this improvement to June 30, 1891, was $190,611.06, and the total amount of work accomplished consisted in the construction of the south dike above mentioned, and the dredging of a channel throughout the entire extent of the improvement, 13 feet in depth at mean low water, with widths varying from 300 to 350 feet. It should be added, also, that for 3,000 feet in the vicinity of the bend at the Stake Light, the width had been increased to 400 feet with low-water depths of from 13 to 14 feet. This latter work was done under contract with Thomas H. Benton, dated March 23, 1891.

This is an important work, supporting a very large amount of commerce, which appears to be increasing in proportion to the successive increments in the capacity of the channel, and the limits of this traffic are still far from being attained. The channel can never be rendered completely permanent, however, because of its transverse position, and will require the appropriation of certain funds from time to time in order to maintain it by dredging.

The expenditures during the fiscal year ending June 30, 1892, amount to $6,665.32, as follows:

Dredging under contract	*$5,881.82
Inspection	9.50
Drafting	75.00
Administration	699.00
Total	6,665.32

No work has been done during the fiscal year other than office work.

This work is in the collection district of New York, which is the nearest port of entry. Nearest light-house, Bergen Point Light; nearest fort, Fort Tompkins.

Amount of revenue collected at the port of New York during the fiscal year ending June 30, 1892, $120,732,613.89.

AMOUNTS APPROPRIATED.

By act of Congress approved—	
June 23, 1874 (diking)	$50,000.00
August 14, 1876 (dredging)	10,000.00
June 18, 1878	15,000.00
June 14, 1880	29,000.00
August 2, 1882	40,000.00
July 5, 1884	10,000.00
August 5, 1886	15,000.00
August 11, 1888	15,000.00
September 19, 1890	15,000.00
Total	199,000.00
Amount expended	197,276.38

Money statement.

July 1, 1892, balance unexpended	$8,388.94
June 30, 1892, amount expended during fiscal year	6,665.32
July 1, 1892, balance unexpended	1,723.62
Amount appropriated by act approved July 13, 1892	15,000.00
Amount available for fiscal year ending June 30, 1893	16,723.62
Amount (estimated) required for completion of existing project	46,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	30,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of the channel between Staten Island and New Jersey, during the year ending December 31, 1891, were compiled from statements furnished by parties making shipments over this water way:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Coal	5,191,396	$19,738,460	Steam	18,431	10½	407
Building material	1,165,442	7,012,282	Sail	12,680	11	[illegible]
Iron and ores	325,943	14,334,510	Barges	19,507	10½	381
Miscellaneous	2,536,700	106,304,167	Rafts	8,142		
Total	9,219,481	147,389,419		58,760		

The above table shows an increase in the commerce of 48,967 tons over that reported for the year ending December 31, 1890.

---

* Outstanding liability, under contract dated March 23, 1891, with Thomas H. Benton, contract completed. (See Annual Report of the Chief of Engineers for 1891, Part II, page 986.)

F 6.

IMPROVEMENT OF PASSAIC RIVER, NEW JERSEY.

The Passaic River is being improved under two separate projects, the first applying to the river below Center Street Bridge, Newark, to and beyond the shoal in Newark Bay, a distance of 7⅝ miles; the second to the upper course of the river from Center Street Bridge as far as Passaic, a distance of 8 miles.

For various reasons, both scientific and economical, it is highly desirable that these projects and accompanying appropriations should be united, in order that the funds may be expended at those points the treatment of which will best conduce to the regulation of the tidal portion of the river in its entirety.

1. BELOW NEWARK.

The lower portion of the river from the Center Street bridge to Newark Bay was first surveyed by the Engineer Department in 1879. The greatest depth in the channel at a point above the Elbow Beacon was only 7.1 feet, and in many places the greatest depth was 7.5 feet at mean low water. A project was adopted, based on this survey, providing for obtaining, by diking and dredging, a channel 200 feet wide and 10 feet deep at mean low water from Center Street bridge to Newark Bay, at a cost of $232,875.

This project was modified in 1884, pursuant to the river and harbor act of that year, providing for extending the dike at the mouth of the river into the bay, a distance of 12,000 feet, and for dredging a channel across the shoal in Newark Bay 200 feet wide and 10 feet deep at mean low water, increasing the original estimate to $353,875.

The amount expended to June 30, 1891, was $200,186.85, with which 6,205 feet of dike had been built, the channel through the shoal in the bay, and the channel up the river to and 1,423 feet beyond the Newark and New York Railroad bridge dredged to the full dimensions as required by the adopted project; thence for a distance of 1,150 feet upstream the channel had been redredged and given a width of 180 feet, and from this point to Lister Dock regulated to a width of 100 feet, with a uniform depth of 10 feet at mean low water throughout. As stated in my last Report, a survey subsequently made, after an intervening winter, showed no appreciable deterioration in the channel thus obtained.

An appropriation of $40,000 was made in the act of September 19, 1890, and a project for its expenditure in widening and deepening the channel to the required dimensions and in enlarging the channel width within the populous districts of the city of Newark to the full width of the stream, upon the urgent desire of the riparian owners, was approved October 4, 1890.

Work under contract dated March 21, 1891, with R. G. Packard, for the removal of 110,000 cubic yards, more or less, of material, at 30 cents per cubic yard (as detailed in my last Report, page 989), was begun September 9, 1891, and continued without interruption until December 19, 1891, at which date the contract was concluded, 100,692 cubic yards having been removed.

During the course of this work the contractor constantly employed four dredges, three of which were engaged in dredging from the channels and the fourth in throwing the material over the dike at the mouth of the river in Newark Bay. The dredge last mentioned was an exceptionally large one, with a boom 130 feet in length, and the material was deposited at a distance of from 75 to 80 feet behind the dike, flowing off in either direction. In this way a ridge of material was formed behind the dike from the Shanley railroad embankment to the point where the dike joins the shore—about 4,000 feet—and it was thought that this embankment would securely protect the dike from the hydrostatic pressure of the inclosed water behind. The portion of the bank nearest the shore end of the dike settled considerably, however, and the interior water found an avenue of escape between the shore line and the dike, which I have recently attempted to check by a sheet-pile dike, erected by authority of the Chief of Engineers under the head of urgently necessary repairs, and given April 19, 1892. This work was completed May 27, 1892, and sufficient time has not yet elapsed to allow of final judgment as to its efficiency, but it may be stated that the present conditions, which undoubtedly threaten the stability of the entire dike, are due to the fact that the embankment made by the Jersey City, Newark and Western Railroad Company, extending from the shore to a point near the southern extremity of the dike, was erected without a sluiceway for the ingress and egress of the tide. The result is that the level of the water within the inclosure is frequently several feet above that of the bay, and the pressure thus produced is tending to overturn the dike. This dike has been of great service in maintaining channel depths at the mouth of the river, and it should be preserved if possible.

Under the contract above mentioned the channel between the Toll Bridge and Center Street Bridge, Newark, from Point-no-Point to Lister Dock, was widened 100 feet, with a mean low-water depth of 10 to 11 feet for a distance of 4,000 feet, giving a total width of 200 feet throughout this distance, and for an additional 3,000 feet the existing 100-foot channel was increased in width by 125 to 150 feet, with the same depth, giving a total width of 225 to 250 feet; this portion, lying in the bend below the city, where there is increased difficulty of navigation and a greater tendency to deteriorate, seeming to call for a slightly greater channel width. In addition to this, a bar above the Zinc Works Dock was removed to the same mean low-water depth, with a width of 120 feet, and for a distance of 1,600 feet.

An examination made immediately after the close of the contract showed that the full depth had been obtained throughout the sections above referred to.

Under date of March 9, 1892, complaint was made to the Secretary of War by the Chapin Hall Lumber Company, through J. M. Chapin, vice-president, against the Pennsylvania Railroad Company, relative to the closing of bridge draws for repair and the consequent interruption of river traffic. This was referred to me for report, and the report rendered on April 6, 1892.

The expenditures during the fiscal year ending June 30, 1892, amount to $33,505.33, as follows:

Dredging under contract	$30,207.60
Repairs to dike in Newark Bay	800.49
Inspection	1,475.24
Drafting	325.00
Administration	697.00
Total	33,505.33

The commerce of this stream, as reported for the year ending December 31, 1891, is 1,528,565 tons, valued at $50,670,875; 30,652 vessels passed through the draw at the mouth of the river during the same period, as against 30,224 in 1890.

Passaic River is in the collection district of Newark, which is the nearest port of entry. Nearest light-house, Passaic Light, at lower end of the dike in Newark Bay. Fort Tompkins is the nearest fort.

Amount of revenue collected at the port of Newark during the fiscal year ending June 30, 1892, is $5,100.16.

AMOUNTS APPROPRIATED.

By act of Congress approved—	
June 14, 1880	$30,000.00
March 3, 1881	50,000.00
August 2, 1882	43,000.00
July 5, 1884	25,000.00
August 5, 1886	24,000.00
August 11, 1888	27,500.00
September 19, 1890	40,000.00
Total	239,500.00
Amount expended	233,692.18

Money statement.

July 1, 1891, balance unexpended	$39,313.15
June 30, 1892, amount expended during fiscal year	33,505.33
July 1, 1892, balance unexpended	5,807.82
Amount appropriated by act approved July 13, 1892 *	45,000.00
Amount available for fiscal year ending June 30, 1893	50,807.82
Amount (estimated) required for completion of existing project †	124,347.00
Amount that can be profitably expended in fiscal year ending June 30, 1894 †	95,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of the Passaic River, New Jersey, below Newark, were kindly furnished by Mr. A. B. Twitchell, Newark, N. J., for the year ending December 31, 1891:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Coal	240,918	$963,672	Steam	13,912	9	475
Fertilizers	342,732	11,426,895	Sail	7,721	8	200
Ice	162,019	648,076	Barges	7,315	6	200
Iron and ores	221,841	11,092,070	Rafts	71		
Building material	332,325	4,106,581				
Grain and malt	24,790	793,281				
Miscellaneous	203,940	21,640,300				
Total	1,528,565	50,670,875		‡29,019		

---

* This appropriation is for the improvement of the entire river.

† These estimates relate to the entire river, both above and below Newark, the amount pertaining to the two reaches of the river being here consolidated.

‡ Exclusive of 1,633 pleasure boats.

The above table shows an increase in the commerce, over that reported for the year 1890 of 44,520 tons.

NOTE.—While the average draft of vessels coming up the Passaic River is probably correct as stated—viz, 6 to 9 feet—it is also true that many vessels come to Newark from the East, the South, and also from foreign ports, drawing 12 to 15 feet, depending upon the tides to reach the city.

The tendency of commerce is towards larger vessels, of increased draft and tonnage, and Newark is thus at a disadvantage, in that vessels of greater capacity can reach adjacent ports than can come up the Passaic.

It is important to the commerce of Newark that the full width as well as depth of channel be maintained, to enable as large vessels as possible to reach Newark wharves.

2. ABOVE NEWARK.

Before its improvement was undertaken the upper part of the river had a navigable 6-foot channel, except at Middle, Belleville, Rutherford Park, and Holzman bars, where the depths were 4.5 feet, 3.9 feet, 3 feet, and 3.5 feet, respectively.

The project of improvement was adopted in 1872, and provided for a channel across and above the shoals from 7½ to 6 feet deep at mean low water, and from 200 to 50 feet wide, to be obtained by dredging and diking, at a cost of $123,924. It was modified in 1885 by extending the channel below Middle Bar 1,500 feet to the Erie Railroad Bridge, increasing the estimate to $129,000, which was further increased in 1886 to $133,762. The deposit of material from freshets, as well as the difficult and costly nature of the dredging, prompted a recommendation to increase this last estimate to $193,822, which was approved October 6, 1890.

Under this project $130,134.67 had been expended to June 30, 1891, and channels of the requisite depth had been dredged from 60 to 75 feet wide, excepting through Third River Bar, which is of recent formation.

The act of September 19, 1890, appropriated $5,100 to be expended upon this improvement. The wording of the act was as follows:

> Improving Passaic River above Newark, N. J.: Continuing improvement, five thousand one hundred dollars, one thousand five hundred dollars of which, or so much thereof as may be necessary, shall be expended in making an examination and survey of said river.

A project for the expenditure of this appropriation in the removal of Third River Bar, by dredging a channel 100 feet wide and 6 feet deep for a distance of about 1,600 feet, and in the removal of bowlders at various points in the river, in response to several complaints, was approved October 6, 1890. At the same time, that portion of the project which contemplated dredging between Middle Bar and the Erie Railroad Bridge was annulled as being unnecessary, recent surveys showing a good channel through this section owing to the removal of sand by private parties for building purposes.

Work under the contract of March 23, 1891, with Richard Parrott, for the removal of about 13,000 cubic yards of material, as stated in my last report, page 991, at 35 cents per cubic yard, was not begun until December 1, 1891, owing to the fact that two works had been awarded the same contractor—viz, Elizabeth River and the Passaic above Newark—and included in one contract. The contractor began operations on the Elizabeth River July 1, 1891, and completed the work October 3, 1891. The entire contract, including both improvements, should have been completed, according to the terms of the agreement, by September 1, 1891, and it was found necessary to grant two extensions, the first from September 1 to December 31, 1891, and the second from December 31, 1891, to May 1, 1892. On the latter date the work was still incomplete, and, it being considered undesirable to recommend any further extension, the contract was closed on April 30, 1892, with a total of 10,718 cubic yards removed and disposed of in various ways by the contractor, partly by deposition behind the dikes and partly by sale as building sand. Under this contract a channel was dredged through Third River Bar 100 feet wide and 6 feet deep at mean low water for a distance of about 800 feet, and for a distance of about 400 feet below this bar the channel was widened by 40 feet with the same depth.

After the completion of the contract as above stated, authority was obtained from the Chief of Engineers to hire a dredge in open market, as being the most economical and advantageous method to pursue in completing the improvement according to the project by the removal of an additional 3,000 cubic yards of material, and an agreement was made to do this at 35 cents per cubic yard, the same price paid under the contract. Work by this method was begun May 2 and finished May 20, 1892, 2,333 cubic yards of material having been removed.

The total amount of material removed under the contract and by hired dredge amounted to 13,051 cubic yards, and a channel has been dredged through Third River Bar 100 feet wide and 6 feet deep at mean low water for a distance of 800 feet. Below the bar the channel was increased in width by 40 feet with the same depth for a distance of 700 feet, and by 20 feet for a further distance of 245 feet, giving a continuous 100-foot channel through this reach having a uniform depth of 6 feet at mean low water.

Channels having substantially the full depth called for by the projects now exist from Passaic City to Newark Bay, and subsequent work will consist principally in maintaining these depths, increasing the width of the channels to the full projected dimensions, and in building such training dikes as may be found necessary.

The expenditures during the fiscal year ending June 30, 1892, were $5,542.39, as follows:

Dredging under contract	$3,751.30
Dredging by hired dredge	816.55
Inspection	584.79
Drafting	75.00
Administration	314.75
Total	5,542.39

The commerce, although by no means as extensive as that of the lower portion of the river, appears to be increasing rapidly; this was reported for the calendar year 1889 to be 315,437 tons, valued at $2,545,077.

Passaic River is in the collection district of Newark, which is the nearest port of entry. Nearest light-house, Passaic Light, at the lower end of dike in Newark Bay. Fort Tompkins is the nearest fort.

Amount of revenue collected at the port of Newark during the fiscal ending June 30, 1892, $5,100.16.

AMOUNTS APPROPRIATED.

By act of Congress approved—

June 10, 1872	$25,000
March 3, 1873	25,000
June 23, 1874	20,000
March 3, 1875	20,000
August 10, 1876	10,000
June 18, 1878	10,000

By act of Congress approved—Continued.	
March 3, 1879	$2,000
June 14, 1880	2,000
August 2, 1882	7,000
July 5, 1884	3,000
August 5, 1886	2,250
August 11, 1888	7,500
September 19, 1890	5,100
Total	138,850
Amount expended	135,677

*Money statement.**

July 1, 1891, balance unexpended	$8,715.83
June 30, 1892, amount expended during fiscal year	5,542.89
July 1, 1892, balance unexpended	3,172.94

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of the Passaic River, New Jersey, above Newark, during the year ending December 31, 1891, were compiled from statements furnished by parties making shipments over this stream:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Building material	230,002	$2,007,211	Steam	255	9	245
Coal	61,241	247,864	Sail	562	9	218
Ice	20,000	50,000	Barges	502	7	239
Miscellaneous	10,968	385,195				
Total	322,211	2,690,270		1,319		

The above table shows an increase in the commerce of 6,774 tons over that reported for the year ending December 31, 1889.

F 7.

IMPROVEMENT OF ELIZABETH RIVER, NEW JERSEY.

This stream, which is 2⅝ miles in length from its mouth to the head of navigation, at Broad street, Elizabeth, has a width of from 50 to 90 feet, and before its improvement the wharves in the city could only be reached at high water by vessels drawing less than 4 feet. Its commerce was estimated at 45,000 tons annually. The range of the tide was about 4.7 feet at its mouth and 3.4 feet at Bridge street.

The project for the improvement was adopted in 1878, and provides for obtaining by dredging a channel 60 feet wide and 7 feet deep at high water from the mouth of the river to the head of navigation, at an estimated cost of $25,530. The estimated cost, under the project of 1878, was increased in 1882 to $43,160, the increase being due to advanced prices.

---

* As the river and harbor act approved July 13, 1892, appropriates $45,000 for the entire river, the amount (estimated) required for completion of existing project, and the amount that can be profitably expended in fiscal year ending June 30, 1894, are included in the estimates for the entire river given in the money statement on page 875.

The total amount expended to June 30, 1891, was $27,265, and a channel was in 1883 dredged with the required depth to within 1,000 feet of the Broad Street Bridge, which somewhat increased the commerce of the creek. This channel, however, soon became almost obliterated because of large deposits of silt and sewage refuse.

The act of September 19, 1890, appropriated $5,000 for the continuance of this improvement, the first allotment since 1882, and a project for dredging the channel as far as possible to the full dimensions required by the original project was approved October 20, 1890.

Operations under a contract dated March 23, 1891, with Richard Parrott, for the removal of 7,000 cubic yards, more or less, of material, at 55 cents per cubic yard (mentioned in my last report, page 993), were begun July 1, 1891, and finished October 3, 1891, the amount of material removed being 6,917 cubic yards. Under this contract shoals were removed from the river at the bend above South street, at South Street Bridge, at John street, at the bend in the river below John street, and at the New York and Long Branch Railroad Bridge, to a depth of 7 feet at mean high water, with widths of 30 to 50 feet, giving a 7-foot mean high-water channel, with widths varying from 30 to 50 feet, from the mouth of the river to within 900 feet of the Bridge Street Bridge, in the town of Elizabeth.

The expenditures during the fiscal year ending June 30, 1892, amount to $4,621.20, as follows:

Dredging under contract	$3,804.35
Inspection	371.85
Drafting	175.00
Administration	270.00
Total	4,621.20

Elizabeth River is in the collection district of Newark, N. J. Nearest light-house, Bergen Point Light. Nearest fort, Fort Tompkins.

Amount of revenue collected at the port of Newark during the fiscal year ending June 30, 1892, is $5,100.16.

AMOUNTS APPROPRIATED.

By act of Congress approved—	
March 3, 1879	$7,500.00
June 14, 1880	7,500.00
March 3, 1881	4,000.00
August 2, 1882	8,000.00
September 19, 1890	5,000.00
Total	32,000.00
Amount expended	31,886.20

Money statement.

July 1, 1891, balance unexpended	$4,735.00
June 30, 1892, amount expended during fiscal year	4,621.20
July 1, 1892, balance unexpended	113.80
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	5,113.80
Amount (estimated) required for completion of existing project	6,160.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	6,160.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Elizabeth River, New Jersey, during the year ending December 31, 1891, were kindly furnished by Mr. Thomas H. Benton, Elizabethport, N. J.:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Coal and coke	8,150	$39,750	Steam	1	8	152
Rope, hemp, etc	5,250	1,250,000	Sail	80	7	100
Building material	21,750	174,850	Barges	255	6	150
Miscellaneous	1,075	1,007,500	Rafts			
Total	36,225	2,472,100		336		

The commerce of this stream, as given above, for the year 1891, when compared with that given for the preceding year, shows a decrease of 4,115 tons, the same being due to the destruction of the cordage works by fire on or about April 1, 1891.

F 8.

IMPROVEMENT OF RAHWAY RIVER, NEW JERSEY.

In its original condition the Rahway River had a depth of 8 feet and more at mean high water from its mouth to Bricktown, 3⅝ miles; 7 feet at Edgar's Dock, 4½ miles; 4.4 feet to Milton Avenue Bridge, 4¾ miles; and 4 feet to Main Street Bridge, 5 miles in the town of Rahway. Its commerce was estimated at 120,000 tons, and three attempts had been made to establish a line of steamboats on the river, but had failed on account of the bad condition of the stream.

The original project for its improvement was adopted in 1878, and provided for dredging a channel 125 feet wide and 8 feet deep at high water from Bricktown to Milton Avenue Bridge, and 100 feet wide from that point to Main Street Bridge. The tide rises about 5 feet at the mouth and 4 feet at the head of navigation.

To June 30, 1891, $37,000 had been expended under this project, which had resulted in the formation of a channel 7 feet deep at high water and from 100 to 50 feet in width to within 550 feet of the head of navigation. It has, however, not proved permanent.

The commerce of the river had not increased, though freight rates to Rahway had been materially reduced as a result of the improvement of the river.

There has been no appropriation for this work since 1882, and there have been no funds for expenditure since the fiscal year ending June 30, 1890.

The condition of the river has deteriorated since the work was suspended and its commerce has decreased, the shoaling of the river having obliged one of the principal shippers to transfer his business to the railroad.

If it is the intention of Congress to complete this improvement, the balance of the estimate, $29,250, could be expended profitably as regards the efficient prosecution of the work during the fiscal year ending June 30, 1894, and would be applied to deepening and widening the channel by dredging.

The estimated amount required for the completion of the improvement in accordance with the approved project is $29,250.

This work is in the collection district of Perth Amboy, N. J., which is the nearest port of entry. The nearest light-house is Princess Bay Light, and Fort Tompkins is the nearest fort.

Amount of revenue collected during the fiscal year ending June 30, 1892, at the port of Perth Amboy, N. J., is $19,072.

Original estimate (1878)	$36,653
Revised estimate (1882)	66,250

AMOUNTS APPROPRIATED.

By act of Congress approved—	
March 3, 1879	$10,000
June 14, 1880	10,000
March 3, 1881	10,000
August 2, 1882	7,000
Total	37,000
Amount expended	37,000

Money statement.

Amount (estimated) required for completion of existing project	$29,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	29,250.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

In regard to the commerce of the Rahway River, New Jersey, the following letter, which contains all the obtainable information, is self-explanatory:

RAHWAY, N. J., *February 8, 1892.*

MY DEAR SIR: In answer to yours of January 22, asking for information in relation to exports and imports through Rahway River, I would say, that, so far as I have been able to ascertain, we had about 2,000,000 brick, together with other mason's material, brought up the river last year. The amount of coal, while an increase of perhaps 100 per cent over the year previous, was a matter of small importance, as tugboats will not attempt to navigate the river owing to the narrow and unfinished condition of the channel as dredged by the Government.

Yours truly,

JOS. M. POTTER.

Capt. THOS. L. CASEY.

F 9.

IMPROVEMENT OF RARITAN RIVER, NEW JERSEY.

Before its improvement by the United States the Raritan River had a depth of 8.5 feet at "The Stakes," 3 miles; of 6.5 feet at the "Middle Grounds," 4½ miles; of 7.5 feet at Whitehead Sand Dock, 8½ miles; and between this point and New Brunswick, 12¼ miles above the mouth, the channel was obstructed by a number of rocky shoals with depths of from 8.4 feet to 6.9 feet at mean low water. The city of New Brunswick and the Delaware and Raritan Canal, which terminates here, together with extensive brick yards on the South River, had an extensive commerce on the stream, estimated in 1871 at 3,053,857 tons per annum.

The present project was adopted in 1874, and provides for obtaining by diking and dredging, and, where necessary, by drilling and blasting rock, a channel 200 feet wide and 10 feet deep at mean low water, from the mouth to New Brunswick, at a cost of $2,093,662.05. It was modified in 1881, pursuant to the river and harbor act of that year, by adding to it the dredging of the south channel, about 13,000 feet long, 100 feet wide, and 5½ feet deep at mean low water, from Kearneys Dock to Crab Island.

Under this project $534,206.58 had been expended June 30, 1891, in constructing the dikes required by the project at "The Stakes" and "Middle Grounds," in dredging channels 200 feet wide and 12 feet deep at mean low water at these points, in drilling, blasting, and dredging a channel of the same dimensions across the rocky shoals at Whitehead Sand Dock, and thence up the river, with a width of 100 feet and a depth of 10 feet, to within 2,800 feet of New Brunswick. Under two special allotments made for it in the acts of March 3, 1881, and August 2, 1882, the south channel was dredged to the required depth for a distance of 4,000 feet. These improvements had been of decided benefit to navigation. The commerce of the river was reported in 1887 at 1,675,355 tons, valued at $28,119,173, and in 1890 at 1,661,425 tons valued at $29,877,365; during the past year it is reported to be 1,566,888 tons, valued at $31,031,299.

The gradual falling off in the commerce from the much larger figure given above for 1871 is due to the purchase and partial disuse of the Delaware and Raritan Canal by the Pennsylvania Railroad, but it is thought that the excavation of a 10-foot channel to the canal locks will stimulate local manufacture to an extent which will more than offset the loss of commerce from this source.

The improvement of this important water-way is now the sole occupation of the Government plant, consisting of a steam dredge, tug, and three shallow draft scows, together with an additional hired tug. The dredge was not especially constructed for the severe work which has been put upon it, but by skillful and cautious management, supplemented by certain changes, such as the substitution of a small and heavy dipper armed with steel teeth for the ordinary bucket, it has fully answered all demands thus far.

The work for the past fiscal year has consisted almost entirely in rock dredging. The material consists of a fine-grained red shale, dipping in thin and much disjointed strata upstream at an angle of about 20°. The shale varies greatly in quality, sometimes being so soft and decomposed that the steel teeth of the dipper can be readily thrust between the strata and the rock thus disintegrated and brought to the surface. In other places it becomes harder, and resort has then been had to surface blasting.

During the month of June, 1891, blasting operations were begun experimentally, as mentioned in my last report, and proved to be very effective, with forcite cartridges of 6 to 12 pounds each, placed in three series along the cut in advance of the dredge for a distance of about 80 feet, and with mutual intervals of from 5 to 10 feet, according to the hardness of the rock. The blasts were fired at high tide in order to secure the maximum effect of water tamping. Generally one blast would loosen the rock sufficiently to obtain the depth required, but sometimes two were necessary, and on resuming work during the past month on the section opposite the lower part of the bulkhead the rock became so hard and compact as to require three sets of blasts with cartridges increased in weight to 15 pounds and placed 5 feet apart. Even with this great expenditure of powder, however, the work is being conducted far within the prices previously bid for such work, as can be seen from the accompanying table.

This system of excavation can probably be adhered to until the improved channel approaches the canal lock, when it is possible that it may become necessary to loosen and break up the rock by percussion, either by means of a pile-driver or some other device, as the locks are so dilapidated that it is doubtful if they could stand the shock of blasts in immediate proximity to them.

The accompanying maps are inserted to indicate the progress made during the fiscal year just closed. Map 1 shows the original state of the river bed, and Map 2 the conditions as they now exist. The few irregularities in the bed of the channel, showing depths of less than 9.5 feet, are of so little material importance that it seems preferable to allow them to remain until the channel can be carried to the locks; it is proposed to then return and remove them.

The following table gives items of cost, saving when compared with prices previously bid for the same work, and other facts in connection with the work of the past fiscal year:

Month.	Total number of working days.	Actual time.		Average amount dredged per actual working day.	Amount dredged and deposited.			Expenses.		Total cost of dredging and depositing per cubic yard.	Total cost per cubic yard, including interest on original cost of plant.*
		Worked.	Lost.		Sand, gravel, and loose shale.	Shale rock blasted.	Total.	Operating, including maintenance while idle.	Repairs.		
1891.		*Days.*	*Days.*	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*	*Cu. yds.*				
July	26	19½	6½	146	2,066	832	2,898	$1,767.60	$192.15	$0.676	$0.728
August	26	16½	9½	64	9	1,051	1,060	1,721.68	81.46	1.701	1.842
September	26	21	5	65	104	1,264	1,368	1,858.69	246.32	1.539	1.648
October	27	22½	4½	52½	58	1,124	1,182	2,011.45	37.80	1.734	1.860
November	23	19	4	127	1,762	647	2,409	1,571.19	19.09	.660	.722
December	26	4	22	276	998	107	1,105	588.27	61.05	.581	.603
1892.											
January	25	......	25	....	....	....	....	147.15	....	....	....
February	24	......	24	....	....	....	....	145.00	....	....	....
March	27	......	27	....	....	....	....	145.00	416.26	....	....
April	26	17	9	42	546	164	710	1,064.06	442.01	2.121	2.331
May	25	18	7	57	655	370	1,025	1,620.36	145.34	1.597	1.742
June	26	16½	9½	56	11	916	927	1,551.30	158.41	1.844	2.005
Totals and averages	307	154	153	82	6,209	6,475	†12,684	14,191.75	1,799.89	1.260	†1.402
								15,991.64			

* Interest computed at 4 per cent.

† (1) The lowest responsible bid which provided for the removal of all materials found, whether rock or softer (in this locality), was that of Elijah Brainard, dated September 7, 1887, at $15.20 per cubic yard. On this basis the total saving at $1.40 per cubic yard would be $175,017.56. (2) On the estimate of $10 for rock and $1 for sand and gravel per cubic yard, allowed in the original project, the saving would be $53,179.76.

The work has been prosecuted during the past fiscal year under the local oversight of Mr. C. S. Kelsey, assistant engineer, whose special report is appended.

The expenditures during the fiscal year amount to $21,282.60, as follows:

Dredging, including operating expenses and repairs	$16,989.63
Repairing dikes	1,600.81
Inspection	1,611.24
Drafting	400.00
Administration	680.92
Total	21,287.60

The amount which can be expended profitably, as regards the efficient prosecution of the work, during the fiscal year ending June 30, 1894, is $100,000, and if appropriated will be expended in carrying the improved channel farther up the river toward New Brunswick.

This work is in the collection district of Perth Amboy, N. J., which is the nearest port of entry. Nearest light-house, Great Beds Light, in Raritan Bay. Nearest fort, fort at Sandy Hook, New Jersey.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1892, $19,072.

AMOUNTS APPROPRIATED.

By act of Congress approved—	
June 18, 1878	$200,000.00
March 3, 1879	60,000.00
June 11, 1880	100,000.00
March 3, 1881	25,000.00
August 2, 1882	25,000.00
July 5, 1884	35,000.00
August 5, 1886	26,250.00
August 11, 1888	50,000.00
September 19, 1890	50,000.00
Total	571,250.00
Amount expended	555,492.18

Money statement.

July 1, 1891, balance unexpended	$37,043.42
June 30, 1892, amount expended during fiscal year	21,282.60
July 1, 1892, balance unexpended	15,760.82
July 1, 1892, outstanding liabilities	1,723.59
July 1, 1892, balance available	14,037.23
Amount appropriated by act approved July 13, 1892	40,000.00
Amount available for fiscal year ending June 30, 1893	54,037.23
Amount (estimated) required for completion of existing project	1,482,412.05
Amount that can be profitably expended in fiscal year ending June 30, 1894	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

REPORT OF MR. C. S. KELSEY, ASSISTANT ENGINEER.

NEW YORK, *June 30, 1892.*

CAPTAIN: I have the honor to make the following report concerning the operations of the United States dredge *Alpha* and plant upon the Raritan River, New Jersey, during the fiscal year ending June 30, 1892:

The plant had been employed continuously, during the working season, since August, 1889, upon the Raritan River, and at the beginning of the current fiscal year the dredged channel, 100 feet wide and 10 feet deep mean low water, had been extended upstream a distance of 7,500 feet and to within 2,800 feet of the canal lock at New Brunswick, the head of tide-water navigation. The details of this work have been given from year to year in your annual report.

Thus far the dredge had obtained the required depth unaided. Fixed shale rock had been encountered, however, during the preceding season over a small section. Equipped with a handle and dipper designed and built after the rock was encountered, the dredge had torn it up in slabs, varying from 1 to 4 inches in thickness, and obtained the full depth over the section without the aid of explosives. The progress was rapid, 140 cubic yards of rock, scow measurement, being removed per day at a cost of 63 cents per cubic yard. It was hoped that the success met with here would be continued on the section along the bulkhead at New Brunswick, where, for a distance of 2,800 feet, old surveys and borings indicated from 1 to 4 feet of rock to be removed. An equal rate of progress would have carried the channel to the canal lock in two years.

At the beginning of the current fiscal year the first of this rock was encountered. It proved on trial to be more compact than that met with the preceding season. The seams lay farther apart. The layers were cemented together by infiltrations of hard limestone. In cases the seams were filled with a deposit of clay of the consistency of hard putty. The strains put upon the dredge in removing this rock were excessive. During fourteen days' trial, of which fifty hours were lost in repairs to dipper, handle, spuds, and machinery, 700 cubic yards, scow measurement, were removed.

Surface blasting was begun as an experiment and given an extended trial throughout the balance of the season. Forcite, a patented explosive, was adopted, a grade containing 60 per cent of nitroglycerine proving most effective.. The work advanced in sections from 40 feet to 80 feet long by 20 feet, the width of cutting. Charges of from 6 pounds to 12 pounds weight were spaced along a line about 8 feet apart, lengthwise of the cut, weighted and lowered to the bottom from the side of the scow, the dredge and scow removed a short distance, and the blast fired. The loose material had previously been cleared from the section. Three such strings of cartridges, one in the center and one on each side of the cut, were in succession placed in position and fired before dredging began. If the dredge could not then obtain the depth, further blasting was employed according to the requirements of the work.

Early in the work a number of blasts missed fire. Investigation showed the failure to occur from an occasional faulty exploder. A tester was procured and thereafter the exploders for a blast were connected up, tested, and inserted in the cartridges without breaking connections. No further failures have occurred.

The varying quality of the rock, changing several times perhaps during a single day's progress from a shale, brittle and slaty, to one as firm and solid as a sandstone, or perhaps into a rotten shale, crossed with seams and weakened by voids and pockets of dry clay, made uncertain the extent or depth to which a section would be loosened by the blasts; here from 1 to 2 feet below the depth required, there scant or undisturbed. If after two or three trials a surface was still a few tenths shoal, it was passed over, the small practical gain not compensating for the time required. Obstinate sections were abandoned temporarily and approached from another direction later, getting a different angle of attack.

The strains were such as none but the stoutest machine could endure. No serious failure occurred. Minor breaks and delays were frequent. The dipper handle and dipper teeth, spuds and spud-points were the weak places. Various forms of teeth and methods of attachment to the shell were tried. None lasted for any length of time. Notwithstanding the large percentage of time lost in repairs, supplying new parts, blasting, moving to let tows pass, clearing ridges of loose blocks dangerous to navigation, as well as the required maintenance of two tugs to dispose of so little material, it was demonstrated that the channel could be excavated in this manner and at a small cost, as compared with the usual method of drilling and blasting. The varying nature of the rock with its seams and soft pockets, as well as the light depth to be removed, were against the economical employment of the drilled-hole system. No additional plant or crew were required for this method, and the one on hand was kept in continual employment.

The work was continued, as above described, from July 16 to November 14, during which time the dredge worked 756 hours and lost 248 hours; 4,856 pounds of powder were expended in loosening the rock on a section 500 feet by 100 feet; 4,718 cubic yards of rock and 165 cubic yards of gravel, scow measurement, were removed at a cost of $1.62 per yard for excavating and depositing behind dikes at the Middle Grounds. This includes all current repairs and additions, as well as operating expenses.

From November 14 to December 5 the dredge was employed in scraping the loose material from the section above, 400 feet long.

Preparations for the season of 1892 began March 15. They included a spare dipper-handle and repairs to both dippers, a set of dipper-teeth, a new covering for the roof of dredge, new spud chains and points, general overhauling of machinery, and piping, cleaning, and painting throughout. The forged and cast steel teeth used in 1891 proved too hard and brittle. New teeth were designed in the light of the year's experience. The inner and outer legs were made equally strong. Clamps secured them to the shell in such a manner as to protect the weakened section. The center tooth was shortened enough to equalize the strains throughout the set. They were made of Norway iron, warranted to bend before breaking, and tipped with tool steel. They have been in use six weeks now, and show no signs of wear or failure. To thoroughly test the merits of cast steel teeth a set have been made from the improved patterns and are awaiting trial.

During the winter some study was made of the Lobnitz method of rock excavation under water by percussion drills. Trials on a large scale have been successful in the Suez Canal and other places abroad. This rock is apparently especially adapted to that method. The amount of work to be done on the Raritan, and especially the small amount of funds available at any one year, would not warrant the building of any such dredge as Lobnitz employed, said to have cost $250,000, and patented. It was decided to continue the work in the spring by surface blasting.

At the close of the season's work in December a careful examination by sweeping the dredged channel showed blocks of loose shale scattered over the section, pushed out of reach by the dipper and into adjoining cuts. They were of such size and number as to materially decrease the practical working depth of the channel. To gather these up was the first work of the year. This necessitated going over the entire section with the large dipper in half cuts, the dipper working over a quarter circle only, and pushing the blocks not entering the dipper always toward the unfinished side; 454 cubic yards of rock were picked up in this way; 1,210 cubic yards of gravel were scraped from between the bulkhead and channel; and at the lower end of the rock section and just below, where some material had settled during the winter, coming from Fox's Gully.

The accompanying map shows cross sections 10 feet apart, over the area of rock work. A uniform depth of 10 feet mean low water was not obtained. There is, however, a depth of 9.5 feet mean low water or more throughout the limits of the 100-foot channel, excepting two small sections of the south cut which can be improved in connection with the corresponding cut on the new section above. The 9.5 feet curve drawn on the map indicates this channel. A place measurement, based on this and preceding surveys, shows 2,962 cubic yards of rock and 4,555 cubic yards of gravel removed from the section. The reported scow measurement made a total of 5,864 cubic yards of rock, 7,775 cubic yards of gravel, percentage for rock 1 to 2, for gravel 1 to 1.7. A deposit during the winter coming from Fox's Gully, and no part of the place measurement, accounts for the high percentage in gravel.

On May 26 work was begun on the northern cut of the second section. There were 2 feet of rock to be removed. It has proved much harder than any hitherto encountered, without seams, and breaking in irregular faces. The specific gravity is 1.65. Twelve working days were required to advance 100 feet, and 1,600 pounds of powder were exploded in the removal of 347 cubic yards of rock, scow measurement. The dredge was moved to the upper end of the same cut, and better results have been obtained. The dip of the rock may be more favorable to the reversed direction of attack; the quality is the same in appearance.

The work this season being entirely in rock and the output small, one tug has been able to do the towing. This has been a saving over previous years of $500 per month in running expenses, and will keep down the cost per yard should the rock continue hard. There is still a large margin before the limit of economical work will be reached.

With the exception of 284 cubic yards placed in the dikes in course of repairs, the material dredged during the season has been deposited on the dumping ground behind Dike 2, Raritan River. The rock being placed outside of the lighter material deposited in former years, protects it from scour. The capacity of the dumping ground is ample for some years to come.

Should the rock continue as the present run it would seem advisable to make some experiments with the percussion drill. A simple and inexpensive test of the breaking qualities of the rock could be made with an ordinary pile-driver, of the steam-hammer type. A beetle or percussion drill of oak, armed with a steel-cutting wedge, held in position in the ways, and receiving rapid blows from the steam hammer, would break the rock much as a stone mason shatters a block by many light hand-blows delivered in the same spot. The beetle, under light blows, would push aside loose blocks until the fixed rock was reached, an advantage over the raise-and-drop method in which loose rock interferes and subjects the drill and guides to severe cross strains. No alterations would be required in the pile-driver, the beetle being held in position and handled as an ordinary spile. Should the experiment be a success, and promise cheaper work than has been done by surface blasting, a machine could, I think, be equipped with a set of three or four cutters, breaking down the full width of a cut from one position, and at an expense warranted by the amount of this work yet to be done upon the Raritan River.

Very respectfully submitted.

C. S. KELSEY,
Assistant Engineer.

Capt. THOS. L. CASEY,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of the Raritan River, New Jersey, during the year ending December 31, 1891, were compiled from statements furnished by parties making shipments over this waterway:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Coal	429,800	$1,699,768	Steam	1,773	7	210
Building material	634,402	2,571,345	Sail	3,932	7½	134
Iron and ores	37,739	1,132,170	Barges	11,871	7	178
Clay and sand	176,965	219,506	Rafts	183		
Miscellaneous	287,982	25,408,510				
Total	1,566,888	31,031,299		17,759		

F 10.

IMPROVEMENT OF SOUTH RIVER, NEW JERSEY.

Before the improvement of this stream was undertaken by the United States the navigation of the lower 2½ miles of its course had been abandoned, and a canal dredged at private expense from a short distance below Washington to Sayreville on the Raritan River. In 1880, when the present project for improving the river was adopted, the mouth of this canal, on account of its faulty location, had shoaled to a depth of 6.4 feet at mean low water, and the best depth in the canal, some distance above, had decreased to 3.3 feet. Above Washington a depth of 2.7 feet existed to Bissetts, 3⅝ miles, and 2.5 feet to Old Bridge, the head of navigation, 6¼ miles above the mouth of the canal at Sayreville. The range of the tide was 5.3 feet at Sayreville. The town of Washington and numerous brickyards did a commerce on the river valued at $1,249,000.

The present project, adopted in 1880, provides for closing the river below the head of the canal, correcting the direction of the mouth of the latter, and obtaining, by diking and dredging, a depth of 8 feet mean low water to Washington, 6 feet to Bissetts, and 4 feet to Old Bridge, straightening the channel at two points by cutting across the meadow. It is estimated to cost $194,695. There is no present prospect of closing the old mouth of the river, as it is strenuously opposed by the inhabitants, who issue injunctions whenever an attempt is made to place material in that part of the channel. That portion of the project which contemplates cutting across the meadow is also held in abeyance for the present because of many obstacles.

The amount expended on this improvement to June 30, 1891, was $64,400.42. With this amount the direction of the mouth of the canal had been changed, the dikes below Washington completed, and a small amount of dredging done on a shoal above Washington, a shoal at the mouth of the Washington Canal removed, and a channel dredged 60 feet wide through the canal, and 50 feet wide across the shoal in the river below Washington.

Operations under the contract dated March 24, 1891, with Edgar M. Payn, for the removal of about 12,000 cubic yards of material at 38⅞ cents per cubic yard, as detailed in my last report, were begun May 25, 1891, and at the close of the fiscal year ending June 30, 1891, 8,842 cubic yards had been removed. The contract was finished July 15, 1891, the total amount of material removed being 10,551 cubic yards.

Under this contract the channel below the draw of the Raritan River Railroad Company's bridge was given a depth of 4 feet at mean low water, with additional width of 25 feet for a distance of 350 feet, and for a like distance above the bridge the width was increased to 70 feet. At Rourke Reach the channel was given a depth of 6 feet at mean low water, and width of 60 feet for a distance of 860 feet. In addition a bar opposite Whitehead's brickyard was removed to a depth of 8 feet at mean low water, and width of 60 feet for a distance of 450 feet, and at the junction of the canal and South River a channel was excavated 350 feet long, 60 feet wide, and 6 feet deep at mean low water.

The present condition of the river is such that vessels drawing 6 feet can reach the Turnpike Bridge, about 2.4 miles from the mouth, at every stage of the tide.

Authority to have necessary repairs made to the dike at the mouth of South River Canal by hired labor and purchase of materials in open market as the most economical method, at a cost of about $300, was granted by the Chief of Engineers September 29, 1891. Work was commenced September 29 and was completed October 9, 1891, at a total cost of $295.

The expenditures during the fiscal year ending June 30, 1892, amount to $5,152.45, as follows:

Dredging under contract	$4,101.70
Repairs of dikes	295.00
Inspection	167.25
Drafting	225.00
Administration	363.50
Total	5,152.45

The sum of $30,000 can be expended profitably as regards the efficient prosecution of the work during the fiscal year ending June 30, 1894. It would be applied to giving the channel the full dimensions required by the project.

This work is in the collection district of Perth Amboy, which is the nearest port of entry; nearest light-house, Great Beds Light, in Raritan Bay, New Jersey; nearest fort, fort at Sandy Hook, New Jersey.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1892, $19,072.

AMOUNTS APPROPRIATED.

By act of Congress approved—	
June 14, 1880	$40,000.00
March 3, 1881	6,000.00
August 2, 1882	10,000.00
August 5, 1886	5,000.00
August 11, 1888	5,000.00
September 19, 1890	5,000.00
Total	71,000.00
Amount expended	69,552.87

Money statement.

July 1, 1891, balance unexpended	$6,599.58
June 30, 1892, amount expended during fiscal year	5,152.45
July 1, 1892, balance unexpended	1,447.13
Amount appropriated by act approved July 13, 1892	7,000.00
Amount available for fiscal year ending June 30, 1893	8,447.13
Amount (estimated) for completion of existing project	116,695.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	30,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of South River, New Jersey, during the year ending December 31, 1891, were kindly furnished by Capt. Luther Adams, of New Brunswick, N. J.:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Building material	338,700	$803,725	Steam			
Coal and wood	20,315	92,300	Sail	3,472	6	63
Fertilizers	10,320	25,530	Barges	4,110	6	175
Miscellaneous	1,000	124,350				
Total	370,335	1,045,905		7,582		

The above table shows an increase in the commerce of this stream of 6,181 tons over that reported for the year 1890.

F II.

IMPROVEMENT OF KEYPORT HARBOR, NEW JERSEY.

Keyport Harbor was originally accessible at low water only to vessels drawing less than 4 feet. Before its improvement was undertaken by the United States a 6-foot channel had been dredged at private expense which had shoaled in 1872 to 5½ feet and in 1882 to 5 feet, the range of the tide being 4.7 feet. A large commerce was carried on, however, valued at $2,932,000.

The project for the improvement was adopted in 1873, and provides for dredging a channel 4,700 feet long, 8 feet deep at mean low water, and 200 feet wide from the steamboat dock to the 8-foot contour in Raritan Bay, at an estimated cost of $30,475.

The amount expended under this project to June 30, 1891, was $30,475, with which a channel had been dredged from the 8-foot curve in Raritan Bay to Keyport Wharf, a distance of 5,000 feet, with a width of 200 feet for the first 4,200 feet and 160 feet for the remainder.

The commerce of the harbor had increased greatly, being estimated at $5,000,000, besides 150,000 passengers carried annually.

There has been no appropriation for this work since 1882, and there have been no funds for expenditure since the fiscal year ending June 30, 1890.

The dredged channel is stated to have shoaled in places to about 6 feet, mean low water, but it is reported that the commerce as yet shows no falling off.

If it is the intention of Congress to complete this improvement, the balance of the estimate, $10,000, can be expended profitably as regards the efficient prosecution of the work during the fiscal year ending June 30, 1894, and would be applied to dredging the channel to the dimensions required by the project, which would add materially to existing facilities.

The estimated amount required for the completion of the improvement is $10,000.

This work is in the collection district of Perth Amboy, N. J., which is the nearest port of entry. Nearest light-house, Great Beds Light, in Raritan Bay; nearest fort, fort at Sandy Hook, N. J.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1892, $19,072.

Original estimate (1873)	$30,475
Revised estimate (1884)	40,475

AMOUNTS APPROPRIATED.

By act of Congress approved August 2, 1882	$30,475
Amount expended	30,475

Money statement.

Amount appropriated by act approved July 13, 1892	$5,000.00
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Keyport Harbor, New Jersey, during the year ending December 31, 1891, were compiled from statements furnished by parties making shipments over this water way:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Produce	111,220	$4,625,645	Steam	5	6½	453
Brick	70,000	280,000	Sail	85	6	80
Fertilizers	40,000	175,000	Barges	103	6	175
Lumber	10,000	100,000				
Coal and wood	3,550	6,200				
Miscellaneous	6,482	698,920				
Total	241,252	5,885,765		193		

Increase in tons over that reported for year 1890, 18,287.

F 12.

IMPROVEMENT OF MATTAWAN CREEK, NEW JERSEY.

Before its improvement by the Government this small stream was obstructed at its entrance into Keyport Harbor by a mud flat on which the best depth at the worst section was 3.1 feet at mean low water, though the 3-feet channel was too narrow and tortuous for use. Above this flat a good 4-foot channel existed to 1⅛ miles above the mouth and thence to the steamboat dock at Mattawan 3.5 feet, shoaling to 1.8 feet at the freight dock 600 feet above and 1⅞ miles from the mouth. The range of the tide is 4.7 feet. Notwithstanding the above difficulties it carried commerce valued in 1880 at $800,000. In 1885 the commerce of the creek was stated to be 130,000 tons, valued at $2,000,000. It has since increased to 187,850 tons, valued at $2,463,200.

The project for the improvement was adopted in 1881, and provides for dredging a channel 4 feet deep at mean low water and 100 feet wide from the mouth to Winkson Creek, and thence 75 feet wide to the railroad bridge at Mattawan, 250 feet above the freight dock, at an estimated cost of $33,120.

To June 30, 1891, the amount expended under this project was $21,000, with which the channel had been dredged to the required depth from the mouth to the freight dock at Mattawan, with widths varying from 100 to 30 feet.

The Atlantic Dredging Company, under their contract of March 21, 1891, for the removal of about 5,300 cubic yards of material at 37½ cents per cubic yard, measured in scows, began work September 9, 1891, and completed the contract September 26, 1891, having removed 5,028 cubic yards. Under this contract the channel on the north side was given an additional width of 35 feet for a distance of 1,420 feet upstream from the mouth of creek. The channel is at the present time therefore from 90 to 125 feet wide and 4 feet deep at mean low water from Keyport Harbor through to the mouth of creek.

There had been no appropriation for this stream since 1882 until a small one of $2,500 was made in the act of September 19, 1890.

It is thought that $9,620 can be profitably expended in still further enlarging and prolonging the channel to the dimensions required by the project.

The expenditures during the fiscal year ending June 30, 1892, amount to $2,485.87, as follows:

Dredging under contract	$1,885.50
Inspection	169.75
Drafting	150.00
Administration	280.62
Total	2,485.87

This work is in the collection district of Perth Amboy, which is the nearest port of entry. Nearest light-house, Great Beds Light, in Raritan Bay. Nearest fort, fort at Sandy Hook, New Jersey.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1892, $19,072.

AMOUNTS APPROPRIATED.

By act of Congress approved—	
March 3, 1881	$15,000.00
August 2, 1882	6,000.00
September 19, 1890	2,500.00
Total	23,500.00
Amount expended	23,485.87

Money statement.

July 1, 1891, balance unexpended	$2,500.00
June 30, 1892, amount expended during fiscal year	2,485.87
July 1, 1892, balance unexpended	14.13
Amount appropriated by act approved July 13, 1892	9,620.00
Amount available for fiscal year ending June 30, 1893	9,634,13

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Mattawan Creek, New Jersey, during the year ending December 31, 1891, were kindly furnished by Mr. J. W. Maggs, of Mattawan Creek, New Jersey:

Articles.	Amount.	Value.	Vessels.	Number	Average draft.	Average tonnage.
	tons.				*feet.*	
Produce	75,000	$1,875,000	Steam	2	6½	228
Brick	70,000	280,000	Sail	15	5	75
Fertilizers	40,000	175,000	Barges	100	5	150
Lumber	10,000	100,000				
Coal and wood	3,550	6,200				
Miscellaneous	1,300	97,000				
Total	199,850	2,533,200		117		

The above table shows an increase in the commerce of this stream of 12,000 tons over that reported for the year ending December 31, 1890.

F 13.

IMPROVEMENT OF SHOAL HARBOR AND COMPTON CREEK, NEW JERSEY.

Shoal Harbor is situated on the south side of Sandy Hook Bay, 5 miles west of the entrance to Shrewsbury River, New Jersey. The harbor is formed by a slight indentation in the shore line where Compton Creek empties into the bay. The outer harbor is unprotected by projecting headlands or other natural topographical features. The creek is used principally as a harbor for small vessels engaged in the fish and oyster trade, and contains ample depth of water for this purpose, except at the entrance, which nearly runs dry at low water, thus preventing vessels from entering excepting at or near high water.

At a point about one-quarter of a mile above its mouth the creek is crossed by a fixed bridge without a draw, beyond which no vessels ever go. The village of Port Monmouth, located on the left shore of the harbor, is the principal shipping point for garden truck from the adjacent farming districts and for fish and oysters taken in the bay. These products are shipped directly to New York City markets, mostly by a steamboat drawing about 4 feet of water, making daily trips between these points. About 100 sloops, of from 15 to 20 tons burden, are engaged in the fish and oyster trade, and find shelter during stormy weather in the lower reaches of Compton Creek whenever they can enter the same. Its present commerce is reported to be 48,000 tons; mainly farm produce, clams, and oysters.

The first survey with a view to its improvement was made in 1883, by Lieut. Col. G. L. Gillespie, Corps of Engineers, whose report, dated January 7, 1884, may be found in the Annual Report of the Chief of Engineers for 1884, Part I, page 770.

The plan of improvement adopted in 1884 had in view the connection of the 5-foot mean low-water curve of the creek on the inside with the 5 foot curve of the bay by means of a dredged channel 150 feet wide and the protection of this channel against shoaling by means of a timber dike placed on the west side of the harbor, at a total estimated cost of $64,130.

The first appropriation was made in the act of September 19, 1890, the wording being as follows: "Improving Shoal Harbor and Compton Creek, New Jersey, so as to give a channel 4 feet deep at mean low water, $5,000."

The amount expended to June 30, 1891, was $1,649.80, in dredging the channel to a depth of 4 feet at mean low water, under a contract entered into with Elijah Brainard on March 20, 1891, for the removal of about 16,000 cubic yards of material, at 24¾ cents per cubic yard. At the close of the fiscal year ending June 30, 1891, work under the contract was still in progress, 10,808 cubic yards of material having been removed and deposited behind a new bulkhead constructed by the steamboat company; giving an improved channel, with a depth of 4 feet mean low water and width of 70 feet for a distance of 980 feet from steamboat dock.

The work done during the present fiscal year consisted in the completion of the contract above mentioned by the removal of 4,921 cubic yards additional, making a total of 15,729 cubic yards, the contract being completed July 29, 1891. The resulting channel is 1,200 feet in length, beginning at the bulkhead at the mouth of the creek and having a width of 100 feet for the first 800 feet and of 70 feet for the remainder, the mean low-water depth being 4½ feet.

The sum of $8,000 can be profitably expended in further extending and deepening this channel to the 5 feet required by the project.

The expenditures during the fiscal year ending June 30, 1892, amount to $3,350.20, as follows:

Dredging under contract	$2,691.86
Inspection	111.70
Drafting	150.00
Administration	396.64
Total	3,350.20

This work is in the collection district of Perth Amboy, which is the nearest port of entry; nearest light-house, Navesink Light, and nearest fort, fort at Sandy Hook, New Jersey.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1892, $19,072.

AMOUNTS APPROPRIATED.

By act of Congress approved September 19, 1890	$5,000
Amount expended	5,000

Money statement.

July 1, 1891, balance unexpended	$3,350.20
June 30, 1892, amount expended during fiscal year	3,350.20
Amount appropriated by act approved July 13, 1892	3,000.00
Amount (estimated) required for completion of existing project	56,130.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	8,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of Shoal Harbor and Compton Creek, New Jersey, during the year ending December 31, 1891, were kindly furnished by Capt. Benjamin Griggs, of Port Monmouth, N. J.:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Farm produce	27,000	$100,000	Steam	1	4	496
Coal	3,000	15,000	Sail	120	2	30
Clams and fish	7,000	12,000				
Fertilizers	10,000	15,000				
Miscellaneous	1,000	15,000				
Total	48,000	157,000		121		

The above table shows an increase in the commerce of about 12,500 tons over that reported for the calendar year 1890.

F 14.

IMPROVEMENT OF SHREWSBURY RIVER, NEW JERSEY.

The project for this improvement was adopted in 1879, and contemplates the formation of a channel 6 feet deep at mean low water and from 300 to 150 feet in width from the mouth of the river to Red Bank, on the North Branch, 8 miles, and to Branchport, on the South Branch, 9 miles.

In its original condition the river was much obstructed by sand bars, on which the best depths at mean low water were, at the mouth, 3.9 feet; below Highlands Bridge, 5.4 feet; at Lower Rocky Point, 3.6 feet; at Barley Point, 3.3 feet; at Chalmers, 5 feet; at Oceanic, 5.5 feet; below Bullevue, 3.1 feet; at Seabright, 4.2 feet; at Jumping Point, 2.6 feet; at Sedge Island, 2.8 feet. A survey completed in 1887 shows the depths at these points to have materially increased, being at the mouth 5.9 feet and below Highlands Bridge 7.7 feet; and in 1891 the depths had still further increased, especially at those points which were the most unfavorable in this respect before the work of improvement had been begun, viz, at Lower Rocky Point a good channel with a minimum depth of 7.1 feet, and at the cross-over between Barley and Upper Rocky Points a channel of about 7 feet. On the South Branch, where depths were never as good as on the North Branch, there were in 1891, at the close of dredging operations, a channel below Bellevue of 4.5 feet, at Seabright of 6.2 feet, and at the bend at Sedge Island of 6 feet; this part of the channel is, however, very liable to shoal, and is probably materially shallower at the present time. The fine sand composing the bottom is so movable that it is quite impossible to foretell the position or extent of the new shoals which appear each spring, due to the winter's storms and tides; but during the summer the channels can be maintained in a fairly stable condition because of their navigation by paddle steamers and the comparative absence of severe storms.

A portion of the $10,000 appropriated by the act of September 19, 1890, was expended in building a temporary sheet-pile spur-dike at Upper Rocky Point, for the purpose of deflecting the ebb tide into the cross-over, extending thence to Barley Point. This dike was erected in

May, 1891, and is marked N on the accompanying map. It was built with as little expense as possible, so that if the object had in view were not accomplished, it could be readily taken up and the timber disposed of by sale. Map No. 3 in my last report shows the condition of this part of the river at the time the dike was constructed, and the present map shows the condition of the cross-over channel as it existed in the latter part of December, 1891. I have been unable to make a survey this spring from lack of funds, but the master of the steamboat running from New York to Red Bank states that the cross-over is in excellent condition. A farther extension of the dike is therefore probably unnecessary at present, and the necessity of having a permanent dike in this location can be determined fully before the present temporary one becomes useless.

The total amount expended upon this improvement to June 30, 1891, was $218,498.10, with which numerous dikes had been constructed and channels dredged in various parts of both the North and South Branches. The dike at the mouth has been of material benefit in maintaining the channel depth over the bar, and, as it had fallen into an unstable condition from loss of stone filling, it was repaired during October, 1891, by depositing 450 cubic yards of dock stone along a portion of the face of the dike at the rate of 1 to 1½ cubic yards per linear foot.

Besides this, the work accomplished during the fiscal year just closed consisted in dredging in the South Branch, under contract with P. Sanford Ross, dated March 20, 1891, for the removal of about 11,000 cubic yards of material, at 35 cents per cubic yard. Work began May 13, 1891, and was in progress at the close of the fiscal year ending June 30, 1891, but was completed the next day, July 1, 11,390 cubic yards having been removed and deposited behind the dike along the channel. Under this contract the channel in the South Branch between Sedge Island and Seabright was redredged to a depth of 6 feet at mean low water, with a width of 100 feet, for a distance of 900 feet.

The authority of the Chief of Engineers was obtained August 4, 1891, for the removal of a shoal in the channel of the North Branch above Upper Rocky Point, upon which the steamers of the Merchants Transportation Line were reported to ground at certain stages of the tide, the work to be done by hiring a dredge in open market at a rate not to exceed $6 per hour, as the method most economical and advantageous to the Government, the total cost of removal not to exceed $650. This work was begun August 1, and finished August 9, 1891, and the shoal removed to a depth of 6 feet to 7 feet at mean low water, and width of more than 100 feet, the total amount of material removed being 1,956 cubic yards, at a total cost of $564. The shifting sand of the river-bed during the past winter again partially destroyed this channel, and funds having become exhausted, the steamboat company was forced to dredge away this obstruction at its own expense. On the 10th and 11th of August, 1891, a small shoal in the cross-over channel was removed by the Merchants Transportation Line, also at their own expense, to a depth of 6 feet mean low water and width of 60 feet for a distance of 90 feet, the amount of material removed being 445 cubic yards and cost $144.

It is thought that an appropriation of $15,000 could be utilized in dredging and restoring the dikes, which are in many places greatly in need of repair, and an additional amount of $8,000 is recommended in order to strengthen the shore line of Sandy Hook at a point between Life-saving Stations 2 and 3, where the hook becomes very narrow and liable to be washed out and breached by heavy storms, thus filling up the Shrewsbury River with sand. This portion has heretofore been kept in repair by the New Jersey Central Railroad Company, but since their abandonment of the route, by War Department order, in October, 1891, the narrow portion mentioned should be cared for by the Government.

In addition to the steamers which regularly use the river a large number of small sailing vessels are engaged in the shipment of coal, sand, fish, and oysters.

The estimated cost of the existing project is $254,562, of which $218,498.10 had been expended June 30, 1891.

The expenditures during the fiscal year ending June 30, 1892, amount to $5,961.58, as follows:

Dredging in South Branch	$3,986.50
Riprapping spur-dike in North Branch	800.00
Riprapping Dike B, at mouth	450.00
Dredging by hired labor in North Branch	564.00
Inspection	93.85
Surveying	59.18
Administration	8.05
Total	5,961.58

This river is in the collection district of Perth Amboy, which is the nearest port of entry; nearest light-house, Navesink Light; nearest fort, fort at Sandy Hook, New Jersey.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1892, is $19,072.

AMOUNTS APPROPRIATED.

[Old project.]

By act of Congress approved—	
August 30, 1852 (survey)	$1,500.00
March 3, 1871 (dredging)	14,000.00
March 3, 1873 (dredging)	5,000.00
	20,500.00

[Existing project.]

By act of Congress approved—	
June 18, 1878 (diking)	18,000.00
March 3, 1879	10,000.00
June 14, 1880	30,000.00
March 3, 1881	86,000.00
August 2, 1882 (dredging)	30,000.00
August 5, 1886 (diking)	10,000.00
August 11, 1888	10,000.00
September 19, 1890	10,000.00
	204,000.00
Total	224,500.00
Amount expended	224,459.68

Money statement.

July 1, 1891, balance unexpended	$6,001.90
June 30, 1892, amount expended during fiscal year	5,961.58
July 1, 1892, balance unexpended	40.32
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	10,040.32

Amount (estimated) required for completion of existing project	$20,062.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	20,062.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The following statistics relative to the commerce of the Shrewsbury River, New Jersey, during the year ending December 31, 1891, were kindly furnished by Capt. James S. Throckmorton, of Red Bank, New Jersey:

Articles.	Amount.	Value.	Vessels.	Number.	Average draft.	Average tonnage.
	Tons.				*Feet.*	
Produce	200,000	$2,000,000	Steam.	42	4½	350
Oysters and fish	7,000	700,000	Sail.	92	3	25
Fertilizers	65,000	455,000	Barges.	32	8	25
Coal	75,000	300,000	Rafts.	15		
Miscellaneous	276,000	2,770,000				
Total	623,000	6,225,000		181		

The above table shows an increase in the commerce of 66,500 tons over that reported for the year ending December 31, 1890.

F 15.

IMPROVEMENT OF MANASQUAN (SQUAN) RIVER, NEW JERSEY.

In its original condition this stream had a depth of from 4 to 6 feet at mean low water for several miles above its mouth, and was obstructed at its outlet into the ocean by a sand spit, which had deflected the stream into a channel parallel with the beach, communicating with the ocean across shifting sand bars, on which the best depth did not exceed 1½ feet at mean low water; mean range of tide, 2.4 feet. In severe storms this channel was sometimes entirely closed by the sand.

The project for its improvement was adopted in 1879, and contemplated dredging the lower river and obtaining by means of jetties a permanent outlet nearly at right angles to the beach, with a depth of 6 feet at mean low water, at an estimated cost of $52,120. This was increased to $72,000 in 1882, the increase being due to advanced prices and to a proposed increase in the length of the jetties.

The amount expended under this project to June 30, 1887, was $39,000, with which two jetties had been constructed, but neither to its full length, appropriations having ceased in 1882. No permanent improvement had been effected.

A detailed account of this work was given in my last report, page 1010, *et seq.*

There were no expenditures on account of this work during the fiscal year.

This work is in the collection district of Perth Amboy, N. J., which is the nearest port of entry. Nearest light-house, Great Beds Light, in Raritan Bay; nearest fort, fort at Sandy Hook, New Jersey.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1892, $19,072.

AMOUNTS APPROPRIATED.

By act of Congress, approved—	
March 3, 1879	$12,000
June 14, 1880	20,000
August 2, 1882	7,000
September 19, 1890	2,000
Total	41,000
Amount expended	39,000

Money statement.

July 1, 1891, balance unexpended	$2,000.00
July 1, 1892, balance unexpended	2,000.00
Amount (estimated) required for completion of existing project	31,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

APPENDIX G.

IMPROVEMENT OF DELAWARE RIVER, PENNSYLVANIA AND NEW JERSEY, SCHUYLKILL RIVER, PENNSYLVANIA, AND RIVERS IN SOUTHERN NEW JERSEY; HARBOR IMPROVEMENTS IN DELAWARE RIVER AND BAY; CONSTRUCTION OF PIER AT LEWES, DELAWARE; DELAWARE BREAKWATER, DELAWARE.

REPORT OF MAJ. C. W. RAYMOND, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Delaware River, Pennsylvania and New Jersey.
2. Harbor between Philadelphia, Pennsylvania, and Camden, New Jersey.
3. Schuylkill River, Pennsylvania.
4. Ice harbor at Marcus Hook, Pennsylvania.
5. Ice harbor at head of Delaware Bay, Delaware.
6. Construction of iron pier at Delaware Bay, near Lewes, Delaware.
7. Delaware Breakwater, Delaware.
8. Rancocas River, New Jersey.
9. Alloway Creek, New Jersey.
10. Maurice River, New Jersey.
11. Removing sunken vessels or craft obstructing or endangering navigation.

EXAMINATION.

12. Location and plan for harbor of refuge for deep-draft vessels near mouth of Delaware Bay.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., July 9, 1892.

GENERAL: I have the honor to transmit herewith the annual reports for the works of river and harbor improvement in my charge for the fiscal year ending June 30, 1892.

Very respectfully, your obedient servant,

C. W. RAYMOND,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

G 1.

IMPROVEMENT OF DELAWARE RIVER, PENNSYLVANIA AND NEW JERSEY.

The project for this improvement, from Philadelphia to the sea, is based upon the report of a Board of Engineers, dated January 23, 1885, and published in the Annual Report of the Chief of Engineers for 1885. It provides for the formation of a permanent channel 26 feet deep at mean low water and 600 feet wide at all points where a less depth and width exist between deep water in Delaware Bay and a point about midway between the American Shipbuilding Company's yard and the Gas Trust Wharf in the city of Philadelphia, by diking, dredging, and rock removal.

The project for the improvement of the river between Trenton and Bridesburg was approved February 28, 1890, and is published in the Annual Report of the Chief of Engineers for 1890. It provides for the formation of a channel 12 feet deep at mean low water over Kinkora Bar by the construction of a dike and dredging.

Expenditures during the past fiscal year have been applied to the following operations:

1. Examinations and surveys at Five Mile Bar, Mifflin Bar, Cherry Island Flats, and Baker Shoal, to determine the action of works already built and the condition of the channels at these localities.
2. Improvement and examination of Kinkora Bar.
3. Improvement and survey of Bulkhead Bar.

These operations will be described in the above order.

1. EXAMINATIONS AND SURVEYS.

Five Mile Bar.—This obstruction lies directly above the upper end of Petty Island in the port of Philadelphia. The works existing for its improvement consist of a dike extending from the New Jersey shore at Fishers Point to within 2,000 feet of the head of Petty Island. At the close of the fiscal year ending June 30, 1890, the dike had reached an extension of 4,500 linear feet, of which the upper 3,500 linear feet consisted of a random-stone dike founded upon a brush-mattress sill and backed with gravel and bowlders derived from the excavation of the channel at Port Richmond, and the lower 1,000 linear feet of a pile dike filled with stone. The tops of these constructions were carried to a height of 2 feet above mean high water. This dike has not been extended during the past two years.

At the close of the fiscal year of 1891 the action of the dike had formed a channel from 12 to 13 feet deep at mean low water and 150 feet wide across the bar. An examination made in June, 1892, shows that there is now a channel from 12 to 13 feet deep and from 200 to 300 feet wide across the bar; that the flood channel north of the bar has moved upstream; that the ebb channel south of the bar has moved slightly downstream and has deepened in the vicinity of the crossing, and that the 12 and 18 foot contours in the same locality have moved from 50 to 200 feet to the southward. The changes are generally favorable.

Mifflin Bar.—This obstruction lies about 10 miles below Philadelphia. The existing works for its improvement consist of a random stone dike upon a brush-mattress foundation extending from the Pennsylvania shore at Hog Island to the head of Maiden Island, a distance of 7,200 feet. The object of the dike is the improvement of the main ship-channel over Mifflin Bar by the concentration of the tidal currents. The dike was commenced in 1885 and completed to the height of mean low water in September, 1888. Since that date no additions have been made to the work.

At the close of the fiscal year of 1891 the channel across the bar dredged in 1888 carried a mean low-water depth of 25 feet over a width of 175 feet, the width having been reduced from 200 feet. The 24-foot channel, with its original width of 275 feet, remained unchanged. The lower part of the channel had materially increased both in width and depth. An examination made in June, 1892, shows that the changes in progress have all been favorable, the 25-foot channel having now a minimum width of 200 feet and the 24-foot channel a minimum width of 350 feet.

From the frequent examinations made at Mifflin Bar since the completion of the dike to the plane of mean low water in 1888, it is evident that to maintain a 26-foot low-water depth in a channel 600 feet wide across the bar the present dike between Hog and Maiden Islands will have to be materially raised in height. The cost of raising this dike to the plane of high water will be about $100,000.

Cherry Island Flats.—These flats are situated about 24 miles below Philadelphia and just above the mouth of the Christiana River. They lie in mid-stream, separating two channels, neither of which had originally sufficient depth for the purposes of commerce. The western channel had an average low-water depth of about 19 feet.

The formation of a channel west of the flats, having a width of about 470 feet and a depth of 24 feet at mean low water, was commenced in 1879 and completed in 1884, the length of the cut being nearly 2 miles. In this work 1,594,740 cubic yards of material were removed by dredging, at a cost of $400,000.

The general project for the improvement of the river provides for the widening of this channel to 600 feet and an increase of depth to 26 feet at mean low water. Frequent examinations since 1884 show that the cut shoals very slowly, so that it is more economical to maintain it by dredging at long intervals than by the construction of dikes. An examination made during May, 1892, shows that the channel has shoaled about 1.2 feet over a distance of about 10,000 feet.

Baker Shoal.—This shoal is situated about 48 miles below Philadelphia and just below Reedy Island. It forms a serious obstruction in the main ship-channel, carrying a depth of only 20 feet at mean low water. The improvement, as proposed by the Board of Engineers of 1884, is to be accomplished by a dike nearly 5 miles in length, extending from the lower end of Reedy Island to a point on the right bank of the river, below the mouth of Blackbird Creek.

The construction of this dike was commenced in 1887 and continued until December, 1889. During this interval the dike was raised to the level of mean low water over a distance of about 6,000 feet. The method of construction employed is described in the Annual Report of the Chief of Engineers for 1890. Since 1889 no work has been done on this dike, as the necessities of commerce required the immediate improvement of the channel at Bulkhead Bar, where the results of the work were expected to furnish valuable information for the continuation of the improvement at Baker Shoal.

During the past fiscal year a detailed survey of the channel in this locality has been made to determine the changes in progress, and to furnish the basis for a project for the continuation of the improvement. The plotting of this survey is now in progress.

2. IMPROVMENT AND EXAMINATION OF KINKORA BAR.

This locality is situated in the reach of river between Trenton, N. J., and Bridesburg, Pa., and about 25 miles above the foot of Market street, Philadelphia. In its natural condition Kinkora Bar carried a ruling depth of 7½ feet at mean low water and formed the only obstruction to a 12-foot low-water channel as far up river as Whitehill, or to within 5 miles of Trenton.

The project for the improvement of this locality, approved February 28, 1890, proposed the formation of a 12-foot low-water channel across the bar by the aid of a dike, partly closing the slough south of Newbold Island, supplemented by dredging on the line of the proposed channel.

During the year 1890 the dike was built and a channel about 175 feet wide and 12 feet deep at mean low water was dredged across the bar. The total cost of this work was $12,648.23.

During the past fiscal year, under an open-market agreement with Michael Herron, dated June 2, 1892, 308 cubic yards of stone were placed in the dike to fill depressions caused by settlement.

From an examination made at the close of the past fiscal year it appears that the dredged channel has shoaled considerably and the line of deepest water has moved about 250 feet to the westward. The minimum depth across the bar is about 8 feet.

3. IMPROVEMENT AND SURVEY OF BULKHEAD BAR.

This locality is situated about 36 miles below Philadelphia, or about 3 miles above Fort Delaware. In its unimproved condition the shoal carried from 20 to 21 feet at mean low water, and although the channel across the bar had been repeatedly deepened by dredging, it soon returned to its original condition, and formed the most marked obstruction to commerce in the navigation of the river between Philadelphia and the sea.

The project of the Board of Engineers of 1884 for the improvement of this locality proposed the construction of a random stone dike, about 14,000 feet in length, brought to the height of mean low water, and extending along the easterly side of Bulkhead Shoal from the upper end of Pea Patch Island, upstream, in a curved line approximately parallel to the New Jersey shore opposite.

For reasons given in the Annual Report of the Chief of Engineers for 1890, page 872, a project was submitted, and approved May 15, 1890, in which pile dikes filled with stone were submitted for the previously proposed random stone dikes, and east and west dikes in place of the single dike along the west side of the channel. Under this revised project the lengths of the east and west dikes are, respectively, 4,200 and 6,800 linear feet, and their estimated cost $280,000.

Under date of July 26, 1890, a contract was made with Colin McLean for the construction of 2,600 linear feet of the east dike; and on March 5, 1891, a contract with Isaac H. Hathaway for the construction of the remaining 1,600 linear feet of the east dike.

During the past fiscal year about 1,300 linear feet of the east dike were constructed under the contract with Colin McLean, the contract being completed on February 5, 1892. Under the contract with Isaac H. Hathaway, 1,350 linear feet of the east dike were constructed, the contract being practically completed on June 30, 1892. The total length of the east dike, including the shore extension, is 4,053 feet.

Under an agreement with the American Dredging Company of Philadelphia, Pa., dated May 23, 1891, to remove about 45,000 cubic yards of material from the channel as a measure of temporary relief, 4,523 cubic yards of material were removed by dredging, the work being completed on July 2, 1891, by the aggregate removal of 46,810 cubic yards. Under an open-market agreement with the American Dredging Company of Philadelphia, Pa., dated December 19, 1891, 5,000 cubic yards of material were dredged from the shoal at the south end of the channel, the work being completed on January 9, 1892. During November, 1891, and May, 1892, detailed surveys of the channel across the bar were made to determine the changes in progress.

There is now a channel across the bar having a minimum depth of 24 feet at mean low water with a least width of 370 feet, and a minimum depth of 26 feet at mean low water with a least width of 100 feet. A comparison of the surveys of November, 1891, and May, 1892, shows that favorable changes have been in progress since dredging was discontinued, and it is hoped that the current will increase the width and depth of the channel so that no more dredging will be required. The 24-foot contour of the flood channel on the west side of the river has advanced upstream, but as yet shows no deflection towards the Delaware shore. Under these circumstances it is neither necessary nor desirable to commence the construction of the west dike, which will not be required if the flood channel continues to deepen along its present direction. The channel depths across the bar before and after the construction of the east dike are shown on the accompanying sketch.

During the present fiscal year it is proposed to apply available funds to deepening and widening the channel through Cherry Island Flats, and to the continuation of dike construction at Baker Shoal.

Under the provisions of sections 6 and 11 of the river and harbor act of September 19, 1890, the following cases of illegal dumping in the Delaware River and at the entrance to Delaware Bay were reported to the district attorneys of the United States on the dates indicated: February 24, 1891, American Dredging Company, dumping in the channel near Bridesburg; February 6, 1892, steamship *Casos*, discharging ballast in channel at entrance to Delaware Bay; March 4, 1892, steamship *Endsleigh*, discharging ballast in channel at entrance to Delaware Bay; March 4, 1892, steamship *Joseph John*, discharging ballast in channel at entrance to Delaware Bay; June 4, 1892, tug *Comet*, Capt. Edward Gorman, owned by American Dredging Company, dumping in or near channel at and above Mifflin Bar Dike; June 4, 1892, tug *Altoona*, Capt. John Scully, owned by Pennsylvania Railroad Company, dumping in channel opposite League Island.

The Delaware River is tributary to the following collection districts: Trenton, Philadelphia, Wilmington, and Bridgeton. The amount of revenue collected in these districts during the year ending December 31, 1891, was $11,136,128.71.

APPROPRIATIONS.

Act of—	
July 4, 1836	$15,000
June 10, 1872	10,000
March 3, 1873	115,000
June 23, 1874	60,000
March 3, 1875	30,000
August 14, 1876	40,000
June 18, 1878	110,000
March 3, 1879	201,000
June 14, 1880	235,000
March 3, 1881	$250,000
August 2, 1882	286,000
July 5, 1884	200,000
August 5, 1886	210,000
August 11, 1888	250,000
September 19, 1890	240,000
Total	2,252,000

EXPENDITURES.

Total to June 30, 1892	$2,080,721.76
Total amount appropriated on present project to June 30, 1892	900,000.00
Total expenditures on present project to June 30, 1892	728,721.76

Money statement.

July 1, 1891, balance unexpended		$271,640.45
June 30, 1892, amount expended during fiscal year		100,362.21
July 1, 1892, balance unexpended		171,278.24
July 1, 1892, outstanding liabilities	$4,629.67	
July 1, 1892, amount covered by uncompleted contracts	4,122.23	
		8,751.90
July 1, 1892, balance available		162,526.34
Amount appropriated by act approved July 13, 1892		50,000.00
Amount available for fiscal year ending June 30, 1893		212,526.34
Amount (estimated) required for completion of existing project		1,675,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The following statements concerning the foreign commerce of the Delaware River for the year ending December 31, 1891, are compiled from the reports of the Board of Trade, the Commercial Exchange, and the Maritime Exchange of the city of Philadelphia:

Articles.	Gross tons.	Articles.	Gross tons.
Imports.		Wood pulp, paper and manufactures of	5,371
Drugs and chemicals	107,051	Rags and other paper stock	32,040
Groceries and provisions	7,748	Miscellaneous	1,717
Cement	32,507		
Clay	13,057	Total	1,381,871
Coal	697		
Cotton and cotton fabrics	730	*Exports.*	
Coal tar, and pitch of	1,948		
Chalk	30,408	Agricultural implements	99
Glass	3,079	Animals and fowls	14,239
Goatskins, hides, and furs	1,666	Corn and corn meal	69,693
Fruits	14,528	Wheat	184,195
Fertilizers	10,886	Flour	101,180
Hemp, jute, flax, and their fabrics	14,082	Oats and oatmeal	4,838
Hair, and manufactures of	5,088	Oil cake	20,934
Iron ore	406,926	Cars and locomotives	13,246
Iron, manufactured	11,564	Coal	356,994
Tin and tin plates	54,023	Cotton and cotton manufactures	6,169
Ores, metals and manufactures of, others	5,168	Iron, and manufactures of	6,090
Live stock and fowls	46	Other metals, and manufactures of	616
Leather, and manufactures of	638	Lumber, and manufactures of	22,625
Manufactures, others	1,499	All other manufactured articles	10,385
Plaster of Paris	14,249	Groceries and provisions	1,414
Asphalt and asphalt blocks	13,858	Seeds	2,043
Stone, and manufactures of	1,778	Machinery and hardware	480
Salt	15,174	Mineral oil and products	655,901
Sugar and molasses	132,739	Other oils	16,934
Sugar cane	401,831	Beef, pork, and products	30,444
Seeds and plants	2,196	Glucose or grape sugar	5,261
Sulphur ore	28,604	Sugar and sirup	5,920
Silks, and manufactures of	85	Tobacco, and manufactures of	8,159
Tobacco	442	Miscellaneous	3,107
Wines and liquors	772		
Wool and woolen fabrics	7,676	Total	1,540,966

Value of imports	$62,438,219
Value of exports	42,845,724
	105,283,943
Passengers arriving from foreign countries	29,998
Passengers departing for foreign countries	4,627
Total	34,625

Comparative statement of values of exports, imports, and revenue collected.

Year.	Exports.	Imports.	Revenue.
1887	$33, 813, 024	$39, 572, 398	$17, 950, 235
1888	28, 012, 879	45, 020, 132	20, 567, 684
1889	31, 403, 720	50, 996, 802	22, 612, 956
1890	36, 462, 951	56, 067, 011	27, 572, 351
1891	42, 845, 724	62, 438, 219	11, 121, 320

Foreign entrances and clearances.

Class.	Entered from foreign ports.				Cleared for foreign ports.				Total.	
	With cargoes.		In ballast.		With cargoes.		In ballast.			
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
American steam vessels	43	55, 713	....	....	28	49, 626	14	6, 353	85	111, 692
American sail vessels	310	165, 688	5	4, 329	285	174, 553	3	1, 477	603	346, 047
Foreign steam vessels	566	804, 156	144	239, 138	401	644, 862	78	54, 128	1, 189	1, 742, 284
Foreign sail vessels	278	152, 761	28	27, 598	276	175, 821	17	8, 448	599	364, 628
Total	1, 197	1, 178, 318	177	271, 065	990	1, 044, 862	112	70, 406	2, 476	2, 564, 651

The following statements concerning the domestic and coastwise commerce of the Delaware River for the year ending December 31, 1891, have been compiled from returns made to this office by shippers and consignees:

Articles.	Gross tons.	Value.	Articles.	Gross tons.	Value.
Arriving.			*Departing.*		
Brick and terra-cotta	25, 160	$86, 924	Brick	25, 522	$90, 800
Chemicals	8, 194	268, 779	Chemicals	11, 367	365, 639
Coal	268, 716	951, 791	Coal	3, 947, 545	12, 055, 786
Cement and plaster	9, 877	85, 249	Cotton	8, 060	1, 612, 000
Cotton	6, 458	1, 291, 600	Grain	6, 509	204, 530
Grain	26, 384	732. 340	Hay	8, 320	90, 774
Hay	5, 564	48, 179	Iron, pig	44, 901	716, 491
Ice	517, 608	1, 015, 710	Iron, manufactured	97, 967	3, 824, 446
Iron, pig	14, 131	305, 449	Lumber	40, 292	860, 305
Iron, manufactured	85, 206	2, 980, 169	Manure	114, 555	123. 385
Lumber	383, 879	3, 343, 437	Fertilizers	42, 272	953, 637
Oysters and fish	28, 502	463, 050	Oysters	91, 714	1, 284, 000
Produce and fruit	33, 717	1, 290, 350	Petroleum and products	38, 776	1, 831, 394
Phosphate rock	45, 338	337, 900	Produce	5, 080	76, 625
Fertilizers, other	15, 125	185, 397	Sand	40, 931	60, 897
Railroad ties	27, 473	164, 838	Sugar	2, 258	279, 960
Sugar	9, 257	1, 061, 420	Miscellaneous	1, 662, 810	78, 804, 876
Stone, building	88, 523	237, 753	Total	6, 188, 879	102, 226, 045
Stone, paving	57, 166	196, 192			
Sand	666, 471	575, 670			
Wood, cord	21, 878	67, 623			
Miscellaneous	1, 980, 848	76, 742, 316			
Total	4, 325, 475	92, 432, 136			

Passengers arriving at Philadelphia	954, 463
Passengers departing from Philadelphia	957, 310
Total	1, 911, 773

Domestic and coastwise arrivals and departures in cargo.

Class.	Arrivals.	Departures.
Steamers	*15,903	*16,070
Sailing vessels	8,275	11,937
Canal boats and barges	†25,263	‡27,917
Rafts	329	179
Total	49,770	56,103

* Excluding tugboats and ferryboats.

† Including 14,848 railroad lighters between Camden and Philadelphia.

‡ Including 17,253 railroad lighters between Camden and Philadelphia.

SUMMARY.

Freight movement.

	Gross tons.	Value.
Foreign:		
Arriving	1,381,871	$62,438,219
Departing	1,540,966	42,845,724
Domestic:		
Arriving	4,325,475	92,432,136
Departing	6,188,879	102,226,045
Total	13,437,191	299,942,124

Vessel movement.

Steam vessels, foreign trade, arriving	753
Sailing vessels, foreign trade, arriving	621
Steam vessels, foreign trade, departing	521
Sailing vessels, foreign trade, departing	581
Steam vessels, domestic trade, arriving	15,903
Sailing vessels, domestic trade, arriving	8,275
Canal boats and barges, domestic trade, arriving	25,263
Rafts, domestic trade, arriving	329
Steam vessels, domestic trade, departing	16,070
Sailing vessels, domestic trade, departing	11,937
Canal boats and barges, domestic trade, departing	27,917
Rafts, domestic trade, departing	179
Total	108,349

G 2.

IMPROVEMENT OF HARBOR BETWEEN PHILADELPHIA, PENNSYLVANIA, AND CAMDEN, NEW JERSEY.

The original project for this improvement is contained in the report of a Board of Engineers, dated March 30, 1888, and published in the Annual Report of the Chief of Engineers for 1888. It provides for the removal of Windmill and Smith Islands and the adjacent shoals so as to form a 26-foot channel about 1,000 feet wide, or wider if found practicable during the progress of the work along the front of the revised Philadelphia wharf line, from Kaighn Point to the foot of Petty Island. It is further proposed to widen the Pennsylvania Channel at Petty Island so as to give it a width of about 2,000 feet, a depth of 26 feet over a width of about 1,000 feet, more or less, the channel sloping to a depth of 12 feet in the remaining width, and a resulting cross section at half tide of about 55,000 square feet. The quantity of material to be removed is about 18,000,000 cubic yards. The cost of the dredging required to carry out this project was estimated at $3,500,000.

This project provides further for the simultaneous regulation of the port wardens' lines of both shores of the river, so as to maintain the assigned section of the new channel, and the establishment of these lines by actual constructions during the progress of the work.

The river and harbor act approved September 19, 1890, contained an appropriation of $200,000 for continuing this improvement, with the following provisions:

> *Provided,* That contracts may be entered into by the Secretary of War for the work required for the improvement of the Delaware River between the cities of Philadelphia, Pennsylvania, and Camden, New Jersey, according to the plan reported by the Board of Engineers, and transmitted to Congress April seven, eighteen hundred and eighty-eight, and printed as House Executive Document two hundred and sixty, Fiftieth Congress, first session, or such modifications thereof as may be determined upon by the Secretary of War: *Provided,* That the cost of the improvement shall not be thereby increased, to be paid for as appropriations may from time to time be made by law.

The sundry civil act approved March 3, 1891, appropriated $300,000 for continuing the improvement with the following provisions:

> *Provided,* That the plan for the improvement may be modified by changing the line limiting the excavation on Petty Island to such position as the Secretary of War may consider desirable, and the material to be removed from said islands and shoals under this appropriation and appropriations heretofore made shall be deposited and spread on League Island, and to the extent of the cost of such deposit and spreading the said appropriations are hereby made available: *Provided, further,* That the title to any additional lands acquired for this purpose shall be vested in the United States without charge to the latter.

By this legislation the original project was modified by providing for the deposit and spreading of material on League Island, a work which has no relation to the scheme of harbor improvement and the cost of which was not included in the original estimates. At the present contract prices, however, this additional work can be executed without increasing the estimated cost of the improvement.

Previous to the commencement of the past fiscal year the following work had been accomplished.

During the fiscal year ending June 30, 1890, title to the lands necessary for the improvement was vested in the United States.

During the fiscal year ending June 30, 1891, harbor lines conforming to the new conditions were established by the War Department. A contract was entered into with James A. Mundy & Co., of Philadelphia, Pa., for all the work required for the improvement. This contract provided specifically for the excavation of about 700,000 cubic yards of material from Windmill Island, to be deposited on League Island, and the removal of about 8,200 feet of piling and revetment from the shores, the work to be completed on or before December 31, 1891.

On June 27, 1891, at the request of the contractors, the contract was modified by providing for the excavation of about 1,075,000 cubic yards before December 31, 1891, in order to permit a cut of 12 feet instead of 8 feet below mean low water, and thus facilitate the use of deep-draft plant. Under this contract 10,318 cubic yards of material were removed from Windmill Island and deposited alongside of the dike at League Island, and work was in progress upon the removal of 1,260 linear feet of revetment.

A hydrographic survey was made before the commencement of the work.

On December 31, 1891, the date fixed in the contract for the completion of a definite portion of the work, 1,369 linear feet of revetment had been removed; and 170,602 cubic yards of material had been dredged from Windmill Island, 99,229 cubic yards of which had been deposited on League Island and the remainder along the shore preparatory to its deposit on the island. At the request of the contractors, who stated that they had met with unexpected obstacles and delays, the time for the completion of the allotted work was, on December 28, 1891, extended to June 30, 1892.

During the past fiscal year 2,330 linear feet of piling and revetment have been wholly removed and 923 linear feet have been removed to the level of low water; 312,111 cubic yards of material have been dredged from Windmill Island and the adjacent shoal; and 287,736 cubic yards of material have been deposited on League Island. That portion of the dredged material which has not been deposited on League Island has been placed along the south shore of the island near the pulsometers, in shallow water and within the limiting line of scour, and is to be transferred to the island as soon as possible. Payments are made only for material actually placed on the island.

During the year repeated surveys were made at and in the vicinity of League and Windmill islands to determine the changes in progress.

The excavating plant employed in the work is specified in the following table:

No.	Name.	Kind.	Estimated capacity for 12 hours.
			Cu. yards.
1	America	Dipper	1,500
2	Columbus	Endless chain	2,400
3	Norwalk	Dipper	700
4	Randerson	do	1,200
5	Rattler	do	1,500
6	Starbuck	do	800
7	Achilles	Clamshell	1,200
8	Vim	do	1,200
9	Somers	Dipper	700

The following table gives the monthly and total performances of the dredges since the beginning of the work:

Date.	1.	2.	3.	4.	5.	6.	7.	8.	9.	Total.
1891.										
June	10,318									10,318
July	13,682	22,427	6,015	4,548	6,889	253				54,414
August	413	16,171	1,189	12,564	10,279	3,311				43,927
September	5,406	22,347	5,391	11,012	16,041	861				61,058
October		629	256							885
1892.										
March		3,995			1,419		5,686			11,100
April		25,984			11,469	276	966	2,599		41,294
May		23,224			11,623		622			35,469
June	11,311	22,828			8,084	6,106	14,194		1,441	63,964
Total	41,130	137,605	13,451	28,124	65,804	10,807	21,468	2,599	1,441	322,429

By comparison of the survey made in October, 1890, before the commencement of the work, with surveys made in December, 1891, and June, 1892, it is found that, in addition to the material removed by dredging, about 35,000 cubic yards of material have been removed by scour from the shoal below Windmill Island. The surveys show no indications that the movement of this material has produced any injurious effect upon the channels of the river.

The location of the excavation is shown on the accompanying sketch.

In placing the dredged material on League Island three steam pulsometers have been employed. Dredges and a centrifugal pump were also temporarily used for this purpose while the pulsometers were being constructed or repaired. The following is a brief description of the pulsometers:

Pulsometer No. 1.—This is the machine known by the contractors as the "Big Jim." It has a cylinder capacity of 15½ cubic yards, with 26-inch intake and discharge pipes. This pulsometer was at first established on a large boat and pumped material directly from the bottom, where it was dumped by the scows. This arrangement did not give satisfactory results, and in October, 1891, it was established upon a pile foundation. It is now arranged to pump material directly from the scows.

Pulsometer No. 2.—The construction of this pulsometer was commenced in September, 1891, and completed in March, 1892. Its cylinder is established in a water-tight caisson, with its foundation 18 feet below mean low water. It has a cylinder capacity of 33 cubic yards, with 30-inch intake and discharge pipes. It is arranged to pump material from the bottom, where it is dumped by the scows. It will probably be reconstructed so as to pump directly from the scows.

Pulsometer No. 3.—This small machine was established in April, 1892, upon the caisson of pulsometer No. 2, to determine by experiment the practicability of pumping the material directly from the scows. It has a cylinder capacity of 10 cubic yards, with 12-inch intake and discharge pipes, and steam slide valves controlled by hand. The intake pipe has a flexible rubber joint and is moved by a light derrick controlled by hand. The water needed to dilute the material is pumped through pipes arranged for the purpose. The experiments with this machine were so satisfactory that pulsometer No. 1 has been arranged for this method. Its advantages over the method of pumping from the bottom are as follows: It requires the pumping of much less water; all the operations are under view; there is much less liability to stoppage of the pipes by logs, roots, and stones; it is easier to remove obstructions and make repairs; tight-bottomed scows can be employed, and all the material is deposited without loss.

The following table gives the monthly and total performances of the depositing plant since the beginning of the work:

Date.	No. 1.	No. 2.	No. 3.	Dredges.	Centrifugal pump.	Total.
1891.						
July				3,155		3,155
August				12,685		12,685
September	1,330			8,213		9,543
October	1,046					1,046
November	20,055				1,837	21,892
December	50,015				893	50,908
1892.						
January	27,651					27,651
March	709	8,411				9,120
April	36,941		12,859			49,800
May	15,068		21,920			36,988
June	13,711	41,310	9,927			64,948
Total	166,526	49,721	44,706	24,053	2,730	287,736

The greatest performances of the pulsometers per actual working hour were as follows:

	Cubic yards.
No. 1	459
No. 2	452
No. 3	115

The total amount of work accomplished to June 30, 1892, is as follows:

	Cubic yards.
Removal of Windmill Island:	
Material removed by dredging	322,429
Material removed by scour	35,000
Total	357,429

	Linear feet.
Piling and revetment wholly removed	2,330
Revetment removed to low water	923

The cost of this work, not including 34,693 cubic yards of material dredged but not deposited on League Island and 923 linear feet of revetment not wholly removed, was $33,560.27.

	Cubic yards.
Filling at League Island:	
Material deposited on the island	287,736

The cost of this work was $27,334.92.

Under date of June 24, 1892, the contractors applied for an extension of three months of the time fixed for the removal of Windmill Island and the adjacent shoal to the level of 12 feet below mean low water, stating that they expected to excavate and deposit 250,000 cubic yards of spoil during the month of July, 1892, and at least 300,000 cubic yards during each month thereafter. Under date of June 28, 1892, the time was extended to July 31, 1892, with the understanding that if the amount of work anticipated is executed during the month of July, an application for further extension will receive favorable consideration. The application of the contractors and the report and recommendation of this office are appended hereto.

Up to the present time no piers or bulkheads have been advanced to the new harbor lines either on the Philadelphia or Camden shores. The adopted project for the improvement requires the advance of piers and bulkheads during the progress of the work. The work already executed has not sufficiently increased the channel volume to make this advance necessary, but when Windmill Island has been excavated to the level of 12 feet below low water no further excavation should be made in this part of the harbor untill compensation has been provided for, especially on the Camden shore.

It is understood that a sufficient part of the Camden shore will be advanced as soon as dredged material can be obtained from the islands, but under existing law all material removed with funds now available must be deposited on League Island. Unless the advance of a portion of the Camden shore can be provided for it will probably be necessary to transfer dredging operations to the north shore of Petty Island and suspend the work of removing the islands in mid-channel until the filling of League Island has been completed.

This extensive and costly improvement was undertaken by the General Government upon the urgent representations of the local authorities and the leading commercial and trade organizations that it was necessary in order to provide for a large increase in wharf facilities demanded by commerce. The complete and comprehensive reconstruction of the Philadelphia water front forms a most important part of the project, and this part was to be effected during the progress of the work of excavation by the local interests, without the assistance of the General Government. The harbor commissioners for the city of Philadelphia have given this subject careful consideration, and although there are considerable difficulties in the way of preparing a satisfactory plan of operations, it is believed that a practical solution of the problem will soon be reached. At the request of the board of harbor commissioners I submitted to them a preliminary report on this subject on March 10, 1892. This report, being of interest in connection with the improvement, is appended hereto.

The commercial statistics pertaining to this work are included in the statistics accompanying the report for improvement of Delaware River.

This work lies in the collection district of Philadelphia, at which, as a port of entry, there was collected during the year ending December 31, 1891, revenue to the amount of $11,121,320.14. The nearest fort and light-houses are, respectively, Fort Mifflin and Schuylkill River range lights.

APPROPRIATIONS.

Act of—	
August 11, 1888	$500,000.00
September 19, 1890	200,000.00
March 3, 1891	300,000.00
	1,000,000.00

EXPENDITURES.

Total to June 30, 1892	364,208.56
Total appropriations under present project, to June 30, 1892	700,000.00
Total expenditures under present project, to June 30, 1892	64,208.56

Money statement.

July 1, 1891, balance unexpended		$689,973.92
June 30, 1892, amount expended during fiscal year		54,182.48
July 1, 1892, balance unexpended		635,791.44
July 1, 1892, outstanding liabilities	$19,524.54	
July 1, 1892, amount covered by uncompleted contracts	616,266.90	
		635,791.44
Amount appropriated by act approved August 5, 1892		41,000.00
Amount (estimated) required for completion of existing project		2,759,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894		500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

APPLICATION OF JAMES A. MUNDY & CO., CONTRACTORS FOR THE IMPROVEMENT OF THE HARBOR OF PHILADELPHIA, FOR FURTHER EXTENSION OF TIME FOR COMPLETION OF CERTAIN WORK PROVIDED BY THE CONTRACT TO BE COMPLETED BY DECEMBER 31, 1891.

PHILADELPHIA, *June 24, 1892.*

SIR: We, the contractors for the work of improving the harbor of Philadelphia, respectfully request that the time fixed for our contract for the removal of Windmill Island to the 12-foot plane, be extended for a period of three months from June 30, 1892.

Since the very beginning of this work grave difficulties have been encountered, and have not been successfully overcome until within the past ten days; the greatest difficulties have arisen in connection with the deposit of spoil upon League Island, and in the solution of that problem we have spent much time and energy, and a great deal of money. Our experiments and experience have demonstrated that the spoil is of such a nature that it could not have been dumped from cars except by the use of heavy streams of water; and even now powerful pumps must be used to throw streams of water into the scows to cut up the mud and in order to dump it from the scows. Finally, however, the big pulsometer has been completed, its defects have been remedied, and it has been in perfect working order for about ten days. During that period the pump has been timed, and has been found to put ashore at the rate of 1,000 yards of spoil per hour, and on one occasion it went as high as 1,500 yards per hour (750 yards in twenty-nine minutes by actual timing). The small pulsometer and the "Big Jim" are still upon the work, and have been depositing spoil. The capacity of the "Big Jim" when taking mud from the scows will, it is believed, be from 4,000 to 5,000 cubic yards per day, while the new new pulsometer can easily handle 10,000 cubic yards per day. Under these circumstances we feel, in view of the work actually done during the past ten days, that the question of putting the spoil ashore has been settled, and we have now turned our attention to the other end of the work. Circumstances have heretofore caused us to regard the filling in of League Island as the principal thing to be done, but we are now actively engaged upon what, of course, is the real work, the removal of Windmill Island.

Before the pulsometer was completed we had, at considerable expense, kept a large dredging plant upon the work, though we were obliged to keep it working just long enough to get out 1,500 or 2,000 cubic yards per day. That plant we have still here, but as all of our energies have been until recently devoted to the League Island end, we find the output of our dredging plant less than it would otherwise have been. Repairs and alterations are being pushed rapidly, and at the present time two dredges and five scows are almost ready to be again put to work. The following dredges are actually at work to-day, namely, the *Columbus*, *America*, *Achilles*, and *Starbuck*. On the 23d instant these dredges excavated 4,538 cubic yards during the usual working hours. Of this amount the *Columbus* dredged only 1,767 cubic yards, as she had not at the time succeeded in making a good bed for herself, and was, besides, working in a pile of old stone ballast. This dredge has, however, an actual record of 3,500 cubic yards per day, and we now expect her to average fully 3,000 cubic yards per day. The average daily capacity of the plant now at work, as shown by their actual performance, is about as follows:

	Cubic yards.
Columbus	3,000
America (has a record of 2,200 cubic yards)	2,000
Starbuck (is doing about this amount daily)	800
Achilles (has a record of this amount on this work)	1,500
Total	7,300

Arrangements are being made for night work, and a part of the plant will work at night next week, so that the capacity of the plant now at work should then be about 9,000 to 10,000 cubic yards daily, at the very least.

In addition to this the *Norwalk*, now under repairs, will be ready for work in a few days, and has a capacity of 750 cubic yards; the *Rattler*, which met with an accident and sank a few days ago, has been raised, and is almost ready for work. Her capacity is 1,250 cubic yards per day, and she has repeatedly exceeded this amount on the present work. The actual capacity of the plant now on the work is, therefore, between 11,000 and 12,000 cubic yards daily. This output we expect to reach in a few days, and though our dredges have individually reached the amounts allotted to them, we have not yet reached our maximum capacity in one day for the following reasons:

(1) Because the *Norwalk* and *Rattler* are under repairs.

(2) Because so much of our attention has been devoted to League Island that our tug and scow service is not so well organized as it should be, or as it soon will be.

(3) Because five of our scows have been temporarily taken from the work to have their dumping gear improved, as required by the nature of the spoil.

(4) Because we have not yet commenced night work.

In addition to the above-mentioned plant, we have just made arrangements to put upon the work a tugboat, six scows, and at least one dredge. This plant is already in the Delaware and will be at work early next week. When these scows are obtained the output of our present plant will be much increased.

If from any reason the capacity of our plant should prove less than we expect, we will obtain additional dredges. This, we believe, will be an easy matter, now that the pulsometer is at work.

With the plant now under our control, we expect to excavate and deposit 250,000 cubic yards of spoil during the month of July, 1892, and at least 300,000 cubic yards each month thereafter.

Very respectfully,

JAMES A. MUNDY & CO.

Maj. C. W. RAYMOND,
Corps of Engineers.

RECOMMENDATION.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., June 25, 1892.

GENERAL: I have the honor to transmit herewith a letter dated June 24, 1892, from Messrs. James A. Mundy & Co., of Philadelphia, asking an extension of time for the completion of certain work provided for in their contract for the improvement of Philadelphia Harbor, dated April 23, 1891.

The contract, as modified at the request of the contractors on July 6, 1891, by authority of Department letter dated June 27, 1891, provides for the removal of Windmill Island by dredging and scour to a level of 12 feet below mean low water, the amount of material to be thus removed, all of which is to be deposited on League Island, being estimated at 1,075,000 cubic yards, and for the removal of about 8,200 linear feet of piling and revetment inclosing the island.

By the terms of the contract, this work was to have been completed on or before December 31, 1891; but at the request of the contractors the time for completion was, on December 28, 1891, extended to June 30, 1892, by authority of Department letter dated December 26, 1891. The contractors state reasons for the delay in the work and ask a further extension of three months of time for its completion.

The total amount of work accomplished up to and including this date is as follows: Two thousand two hundred and thirty-three linear feet of piling and revetment have been wholly removed, and 1,020 linear feet have been removed to the level of low water. Three hundred and six thousand and fifty-seven cubic yards of material have been removed by dredging, 271,688 cubic yards of which have been deposited on League Island. The last survey, made during the present month, indicates that at least 25,000 cubic yards of material have been removed by scour above the 12-foot plane, making the total excavation about 331,057 cubic yards. This is less than one-third of the work required by the contract.

The contractors give as the cause of their delay the difficulties encountered in establishing a satisfactory plant for the depositing of material on League Island. These difficulties are fully recognized, but they do not furnish a satisfactory excuse for their failure to execute a considerable part of the work. The removal of revetment might have preceeded much more rapidly, notwithstanding the difficulties of depositing material at League Island, yet the contractors, although repeatedly urged to greater progress, have failed to accomplish this part of the work. During the past ten days an average of about 2,928 cubic yards have been dredged at Windmill Island and deposited on League Island. Had a suitable dredging and transporting plant been employed, three times this quantity might easily have been handled, for the depositing plant has been idle for want of material during a large part of the time.

The depositing plant established by the contractors at League Island now consists of three pulsometers, one of which pumps material from the bottom of the river and the others remove it directly from the scows. Owing to the character of the material, much difficulty has been experienced in adapting this plant to the work required. I am of the opinion that with proper management it can now deposit at least 10,000 cubic yards per day. The excavating and transporting plant is not now in a satisfactory condition, but it can be readily improved.

If this work is to progress in future at its previous rate it is not to the interest of the United States to continue this contract. The contractors, however, state in their application for extension that they "expect to excavate and deposit 250,000 cubic yards of spoil during the month of July, 1892, and at least 300,000 cubic yards each month thereafter." This is as rapid a rate of progress as is considered desirable under existing circumstances, and if it can be attained an extension of time for the execution of the work is believed to be to the interest of the United States.

In view of the fact that the contractors have repeatedly made promises in writing which they have not succeeded in fulfilling, I have the honor to recommend that the time for the completion of the work specified be extended to July 31, 1892, with the understanding that if 250,000 cubic yards of material are removed from Windmill

Island and deposited on League Island during the month of July, as proposed by the contractors, an application for further extension will receive favorable consideration.

Should this extension be granted, it should be understood that the United States retains its right to require the contractors to increase the monthly excavation to 400,000 cubic yards, as provided in the contract, should the circumstances of the work render such increase desirable.

Very respectfully, your obedient servant,

C. W. RAYMOND,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

APPROVAL OF RECOMMENDATION.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
June 28, 1892.

Respectfully returned to Maj. Raymond, Corps of Engineers, approved, as recommended.

When such record as may be necessary has been made this paper will be returned to this office.

By command of Brig. Gen. Casey:

THOS. TURTLE,
Captain, Corps of Engineers.

PRELIMINARY PLAN FOR THE RECONSTRUCTION OF THE PHILADELPHIA WATER FRONT SUBMITTED BY MAJOR C. W. RAYMOND, CORPS OF ENGINEERS, TO THE BOARD OF HARBOR COMMISSIONERS FOR THE CITY OF PHILADELPHIA, PA.

PHILADELPHIA, PA., *March 10, 1892.*

DEAR SIR: In compliance with the request of the Board of Harbor Commissioners for the city of Philadelphia, expressed in a resolution adopted July 8, 1891, I have the honor to submit the following preliminary plan for the increase of the landing accommodations at this port:

The project for the improvement of the harbor of Philadelphia, now in process of execution by the United States, has for its principal object the readjustment of the main ship channel, so as to permit the widening of Delaware avenue and the extension of the piers along the water front of the city. This project was adopted by Congress in the act of September 19, 1890, and it requires the progressive extension of the solid filling and piers, during the progress of the work, as a necessary part of the improvement. Thus the early adoption of a plan for the reconstruction of the water front, and the commencement of its execution, are imperatively demanded both by the needs of commerce and the requirements of the project for channel rectification.

GENERAL CONDITIONS.

The preliminary plan of reconstruction now submitted as a basis for the discussions of the board has been prepared to conform to the bulk-head and pier-head lines conditionally established by the Secretary of War, January 20, 1891, in accordance with the provisions of the act of September 19, 1890, and to the conditions imposed by the adopted project for the harbor improvement.

The harbor lines were established "subject to the condition that wharves shall only be extended beyond the present legal port wardens lines, at such times and places as may be approved by the Secretary of War." They are included between Moore and Otis streets. The plan of reconstruction now under consideration, however, terminates at Shackamaxon street, since the lines between Shackamaxon and Otis streets may require readjustment, in view of recent legislation involving a possible change in the location of the projected channel.

Special attention is invited to the provisions of the act of September 19, 1890, under which the harbor lines have been conditionally established. The act provides that "where it is made manifest to the Secretary of War that the establishment of harbor lines is essential to the preservation and protection of harbors, he may, and is hereby, authorized to cause such lines to be established, beyond which no piers, wharves, bulk-heads, or other works shall be extended, or deposits made, except under such regulations as may be prescribed from time to time by him." Under this authority the Secretary of War may prescribe regulations to govern the construction of all structures between the bulk-head and pier-head lines, should he consider such regulations essential to the preservation and protection of the harbor.

The plan of improvement adopted by Congress in the act of September 19, 1890, requires that the solid filling shall in due time be carried out to the new bulkhead line throughout the whole extent of the water front, and that a sufficient number of piers prolonged or newly constructed shall at proper times be extended to the new pier-head line. These conditions are imperative, for they were assumed in determining the cross-sections, channel volumes, and location of the deep-water line which form the basis of the plan established by law.

It is, however, neither necessary nor possible to fully effect the contemplated changes in the immediate future, but regulations governing the method of reconstruction in conformity with these conditions should now be adopted, and no future constructions should be permitted on the water front which are not in accordance therewith.

The establishment of regulations conforming to the conditions above stated involves the consideration of questions which are as difficult as they are important. It is necessary to determine what number of piers will be sufficient to extend to the pier-head line, whether the partial extension of any piers will be permissible, and in what way the method of pier construction adopted will exert an influence upon the channel. These questions have been investigated theoretically, and also by a laborious study of the changes in the river itself. A very brief statement of the problem and the results obtained, to indicate the part played by the reconstructed water front in the general scheme of ratification, is all that can be attempted in this report.

STATEMENT OF THE PROBLEM.

If we suppose the islands and shoals removed, the Petty Island channel widened and solid quay walls built continuously along the pier-head lines of the Philadelphia and Camden shores, we shall have the theoretical rectification which formed the basis of the plan of the board of 1888. The river will be able to permanently maintain its cross-section at every point. The line of deep water will be a smooth and uniform curve near the Philadelphia quay wall and nearly parallel to it. The advance of the Camden shore and the change in the direction and quantity of the ebb current will be the principal agents working to prevent the re-formation of the islands and shoals, while the advance of the Philadelphia shore will have simply corrected the irregularities of the deep-water line and moved it nearer to the line of mid-channel. It is important to notice that an advance of the shore on the convex side produces a scouring effect which extends much farther into the river than an advance on the concave side. This is very plainly indicated by a comparison of all the existing charts.

The advance of the Philadelphia shore line, therefore, so far as it relates to the scheme of channel improvement, has for its object to locate and hold the deep-water line in a proper position rather than to compensate for an increase of channel volume resulting from the removal of the islands and shoals. The depth along the deep-water line is not a matter of importance, since it is sure to be greater than necessary whatever conditions may exist, but the form and location of the deep-water line are matters of great consequence, since this line indicates the character and uniformity of the channel. If the deep-water line exhibits violent and irregular bends, instead of following a smooth and uniform curve, we know that the channel will be irregular and can not be permanently maintained under the action of the ever varying forces at work upon it.

If we now substitute for the solid quay wall along the Philadelphia shore a system of piers separated by considerable distances from each other and extending to the pierhead line, the deep-water line will be deflected inward between the piers. If shorter piers not extending to the pierhead line are constructed in the intervals, the irregularities in the deep-water line will be greatly increased. If the short piers are omitted and the long piers are brought sufficiently near to each other, the deep-water line will be brought practically into coincidence with the location determined by a solid wall. If the piers are of an open construction, permitting a free flow of the currents, a regular deep-water line may be maintained with wider dock intervals than when the piers present solid obstructions inducing irregularities in the movement of the water.

These statements are strikingly illustrated by the hydrographic surveys of 1843 and 1890. In 1843 the number of piers on the water front between Washington avenue and Green street was 80, only 15 of which extended to the pierhead line. The deep-water line presented great irregularities. In 1890 the number of piers in the same interval was 69, of which 42 extended to the pierhead line. Although irregularities still exist in the deep-water line, its uniformity has been greatly improved, in spite of the fact that the waterway has been unduly narrowed, and the average dock interval has been increased.

It may be considered established that the principal cause of hurtful irregularities in the deep-water line is variation in the lengths of the piers. Too great a width between the piers is also a secondary cause of deflection, but the existing conditions are so complicated by the presence of the islands and shoals that the greatest interval between piers which can be permitted without injury to the form of the channel can only be determined by observations during the progress of the rectification. It is certain, however, that greater intervals may be adopted with open piers than with those which present solid obstructions.

CONDITIONS FOR THE PLAN.

The conditions, therefore, which are imposed upon the plan of reconstruction by the project for channel improvement adopted by the United States are as follows:

1. The plan must assure the ultimate extension of solid filling to the established bulkhead line throughout the whole extent of the water front.
2. It must assure the construction or extension of a sufficient number of piers to properly establish the deep-water line; it must require the full extension to the pierhead line of all piers necessary for this purpose; and it must prohibit the partial extension of piers, at least until the new conditions of the channel have been fully determined.
3. It must assure the adoption of methods of pier construction which will permit so far as possible a free movement of the currents.

These conditions will doubtless be enforced to some extent through regulations of the War Department, to be established under the provisions of the act of September 19, 1890, as will be hereafter more fully explained.

Thus far I have considered the problem merely in its relation to the work of improvement undertaken by the General Government; but other important considerations relating to the present and prospective needs of commerce must receive attention in the preparation of a plan for the increase of the landing accommodations of the port. The extent of the water front is limited. A plan which would furnish ample accommodations for the business of the present day might prove inadequate to satisfy the demands of commerce in the future, the extent of which it is now impossible to foresee. The history of similar undertakings in other ports of the world gives us a right to anticipate an enormous increase in the business of the port when its improvement has been completed and a permanent deep-water channel has been established to the sea. It is therefore important that the plan adopted shall so utilize the whole water front as to accommodate in the best possible manner all the present and future commercial interests of the city. To this end the conditions which should regulate the arrangement and dimensions and the methods of construction of the piers and docks should be determined.

It appears to be the general opinion of those having the most experience in matters of transportation that a width of about 80 feet for piers is best adapted to the general purposes of commerce. This width permits a double track along the axis of the pier with temporary storage spaces of sufficient capacity on each side. The docks or water spaces between the piers should be of sufficient width to permit large vessels to lie at both piers and coal on both sides at the same time, leaving a space between for passage to the wharf at the bulkhead line. A width of 250 feet is not too great for these purposes. It is, however, desirable to utilize existing structures so far as possible, and to interfere with private interests only where such interference is unavoidable. In the plan now submitted, therefore, the minimum width of piers has been taken at 75 feet and the maximum width at 100 feet, and I have sought to obtain a dock width of about 200 feet, except in special cases. The plan has been prepared in the following manner:

PREPARATION OF THE PLAN.

1. An accurate map of the water front was constructed from data obtained from the U. S. Engineer Office and the office of the city engineer. Upon this map the harbor lines of the United States, showing the future limits of open and solid filling, were carefully laid down.
2. The names of the riparian owners were obtained from official sources, corrected by personal inquiry, and recorded on the map.
3. A preliminary or trial plan of a system of piers was prepared so as to conform as far as possible with the conditions above established, keeping in view the desirability of utilizing existing structures and interfering as little as possible with private interests.
4. The water front was divided into sections of convenient length, and plans, on a large scale, were prepared, showing for each section the existing water front and

the proposed reconstruction. These plans were sent to the riparian owners and to other interested parties, with a letter requesting a full expression of their views and wishes.

5. After a reasonable time had been given to ascertain the views of interested parties, the plan was carefully restudied in the light of the new information obtained. It is shown, as finally submitted, on the map accompanying this report. Where it has been possible without too great departure from the general plan I have introduced desired changes; but in some cases, especially those connected with railway traffic and requiring exceptional arrangements, I have thought best to leave the question for the consideration of the Board.

I regret that very few suggestions with reference to the plan of reconstruction have been received from the owners of riparian property; for I am aware that the proposed reconstruction will conflict with many interests, and it was my desire to make it conform to those interests so far as possible. It should be remembered, however, that this is submitted merely as a preliminary plan, and its adoption is not recommended until it has received careful revision by the board of harbor commissioners, after full public hearing and discussion.

The best method of procedure to insure the practical execution of this or any other plan of reconstruction will be considered in the sequel. A few explanatory remarks relating to its general character and to the objections which may be made to its adoption are now desirable.

OBJECTIONS TO THE PLAN.

This plan has been pronounced impracticable, and it has been said that "it would be unwise to try such a construction if for no other reason than it would be beyond the necessities of the port, so far indeed that the magnitude of the project would inevitably defeat the improvement scheme itself." The total area of the existing wharves between Moore and Shackamaxon streets is 1,898,600 square feet, and the total area of the new wharves, as laid out upon the plan, is 2,372,700 square feet. It is true, as has been said, that "the most sanguine believer in the growth of the commerce of Philadelphia can not anticipate its expansion in this ratio in the immediate future; and, if carried out, it would certainly deteriorate the value of wharf property in general, the supply being greater than the demand."

These criticisms are based upon a misconception of the character of the plan submitted. It is not intended to attempt the actual construction of such a system of piers in the immediate future or, perhaps, even in the remote future. It is a plan in accordance with which the new water front is to be naturally developed as slowly or as rapidly as the needs of commerce may determine, only a few constructions demanded by the necessities of the channel improvement being now required. It aims to prevent constructions which will injure the harbor, or interfere with its future development to any extent which may be found desirable. Finally, as is explained hereafter, the plan provides for its own modification should its restrictions be found by experience to bear too hardly upon the business interests of any locality.

It has been said that the conditions established to regulate the width of piers and docks adapt the system principally to the necessities of railroads and the transatlantic steamship lines, and that there are other commercial interests which require accommodations of a different character. The business of the transatlantic lines is confined principally to the transportation of articles of bulk, which are received from or transferred to cars and lighters; while the business of the coastwise steamship lines covers a much greater number of small packages of all kinds, which are received from or delivered to a great number of shippers or consignees in smaller lots, thus necessitating greater space upon the piers for the purpose of receiving and delivering, which is mostly done by teams. Thus it appears that for the uses of the coastwise trade some piers are desirable of even greater width than those provided; and wider piers are also needed in some cases for railway companies where two tracks are not sufficient for handling their freight.

On the other hand, the requirements of some other interests can be fully satisfied by piers and docks of very much less dimensions. Thus, for example, the fruit business is transacted in vessels of small or moderate size. The cargoes must be handled rapidly, a portion being transported in wagons from the wharves into the city and a portion being loaded at the same time into railway cars on floats; so that for this business railway tracks along the pier are neither necessary nor desirable.

It has been remarked that "Philadelphia is more than a commercial port; it is, in addition to that, a large manufacturing center, and much of the incidental service in connection therewith is done by water in small craft; and there is just as great a necessity to provide for that feature of the Delaware River commerce as for that that comes across the ocean."

It is to be remembered, however, that these piers occupy a portion of the public domain; and the privilege of such occupation is now and always should be granted to the riparian owner solely upon the condition that his pier shall be so constructed as to subserve not only the needs of his own business, but also the general necessities of commerce. Under certain reasonable conditions every pier, dock, or wharf is open to the general business of the port, and should be so constructed as to utilize the public water space which it occupies in the manner best adapted to the public interest. Under this view of the case, it is not considered desirable to permit a portion of the water front upon which a pier adapted to the general needs of commerce could be constructed to be occupied by an inferior structure adapted only to the requirements of a special business. Small vessels must either occupy portions of the piers or lie at the bulkhead wharves, which offer ample accommodation for a large number. Piers of a width greater than is necessary for the general purposes of commerce must be permitted when they are required for the legitimate necessities of transportation; but the limited water area between the harbor lines should not be utilized for storage purposes beyond the reasonable necessities of transportation; and storage spaces for freight and cars should generally be provided within the bulkhead line at the expense of those interested, and not taken without cost from the area of the water front.

There are, doubtless, some interests which require piers of special construction; for example, the coal interest. In such cases special provisions must be made, but I believe there are no such exceptional cases within the limits of the present project. Some wider piers may be required for the coastwise steamship lines; but it is to be remarked that the plan submitted does not require a reduction of the width or area of any existing pier which is to be permanently retained. However, should this or any other plan be adopted, it is to be considered only as a general guide for the reconstruction of the water front, and power must be vested in some proper authority to authorize variations from the plan when required by the unforeseen necessities of commerce.

METHODS OF CONSTRUCTION.

The methods of bulkhead and pier construction which should be permitted or required must now receive attention.

The method of bulkhead construction now employed along the line of solid filling will not furnish a retaining wall of sufficient stability to properly support the river front of the proposed avenue or to meet the traffic requirements of the new plan for the development of the harbor. The foundations of the new bulkhead should be placed at a depth but little less than the ultimate depth of water to be carried in the dock and their stability should be assured against any forces to which they are likely to be subjected. The bulkhead should extend continuously through the piers and along the whole river front, and it should be so constructed as to reduce decay and the consequent cost of maintenance to a minimum.

The bulkhead illustrated in the accompanying sketch has been designed to meet these requirements. The substructure consists of a pile pier, filled with stones and braced at intervals by strut piles to resist the horizontal thrust of vessels, extending but little above the plane of mean low water. Its front is formed of white oak piles closely driven and its back of 12 by 12 inch square pine timber placed in contact so as to prevent the earth filling from being washed out from behind the bulkhead. The superstructure, above mean low water, is a wall of granite masonry backed with concrete. The timber work of the substructure has ample strength to support the wall, even if the stone filling beneath it should settle; but, if greater rigidity is considered desirable, very simple arrangements can be made for grouting under the foundation after final settlement, through 4-inch terra-cotta pipes built into the concrete backing.

The method of pier construction heretofore generally adopted in Philadelphia consists essentially of a pile substructure, with a crib superstructure above the plane of mean low water. The piles are generally omitted in the outer fifty feet of the pier and replaced by a pier-head or timber crib extending to the bottom of the river. This pier-head has been considered necessary to resist the thrust of ice and give rigidity to the structure. It has probably also been adopted on account of the great depth of water usually found at the outer ends of the piers, where piles, if used, would have been unsupported for a large part of their lengths and the structure would consequently have lacked lateral rigidity.

The piles forming the substructure are usually placed in rows about five feet apart with an interval of five feet between the piles in each row. They are cut off a little above the plane of mean low water, and those in each row are brought into line by clamp pieces attached at their tops. A floor of longitudinal timber is then placed upon this foundation and the crib superstructure is built thereon. In such a method of construction, the piles are not stayed against lateral movement except by the horizontal floor of the crib at the plane of mean low water, and consequently the entire structure is lacking in lateral rigidity. Experience shows that this is the case, piers in this harbor having been overturned owing to this lateral weakness.

Such piers are nominally open pile structures; but, since the piles are spaced at equal distances apart in both directions, they interfere materially with the free flow of the currents below mean low water, while above that plane the flow is entirely shut off by the close crib superstructure.

These obstructions interfere seriously with the proper maintenance of the navigable channel, since they create great local disturbances of velocity. Furthermore, they retain floating sewage and offal in the docks, and make the removal by dredging of much filthy material frequently necessary. The objections to such structures from a sanitary point of view have much weight and should receive full consideration in any comprehensive plan for the development of the harbor.

It is understood that in New York the considerations above mentioned led to the adoption of a method of pier construction which leaves the piers open to a level above the plane of mean high water. Even with sewers discharging at the pier-heads, the objections to close constructions between high and low water are not entirely obviated, since material drifting from the sewers will naturally float into the docks and be retained there to the detriment of the public health.

The most recent practice in New York City, under the Department of Docks, provides for the construction of piers resting entirely upon pile foundations and open to a level well above the plane of mean high water. The following is a brief description of the method of construction:

The piers are built so as to permit, as far as possible, an unrestricted flow of currents through the structure. For this purpose, the piles forming the substructure are assembled in separate groups extending across the axis of the pier. The outer 70 feet constitutes the pier-head; and in this part the groups of piles are about 23 feet apart and consist of two rows about 2 feet between centers, with the piles in each row about 3 feet apart. In the remainder of the pier, the groups of piles are about 10 feet apart and consist of a single row of piles spaced about 5½ feet between centers.

The tops of these piles are cut off about 6½ feet above mean low water, or 2½ feet above mean high water. The tops of the pile groups carry sills or bearing plates which in turn give support to the longitudinal timbers supporting the floor or deck of the pier. The top of this floor is about 10 feet above mean low water or 5½ feet above mean high water.

To give the pier increased rigidity against lateral thrust, oblique or strut piles, with a slope of 8 inches horizontal to 12 inches vertical, are driven alongside of each pile group and securely bolted to the vertical piles and the timber superstructure. As additional security, and for protection against vessels and ice, the four outer or double pile groups are covered at the up and down stream ends with heavy iron plates extending downward from the tops of the piles for a distance of about 6 feet, or a little below the plane of mean low water.

The piles forming these several groups are further stiffened by chocks, stringers, and transverse planking, by which they are rigidly connected so as to form an unyielding and stable pier. The decking of the pier consists of a double thickness of plank 7 inches deep.

The superstructure of the piers consists essentially of longitudinal stringers of 12 by 12 inch timber spanning the distance between the several pile groups. This superstructure seems constructed to carry a breaking load of about 4,000 pounds per square foot, or a safe load of about 1,000 pounds per square foot of deck. Such a safe load corresponds to about 28 tons net on each of the piles forming the substructure.

When the depth of water over the site of the pier is more than 30 feet, random stone is deposited to reduce it to about 26 feet, and the piles are driven through this material into the natural bed of the harbor. This reduction in depth is essential to the stability and regidity of the structure since the length of the unsupported portion of the piles is reduced thereby.

The specifications require the piles to have butt diameters of from 14 to 17 inches and point diameters of from 6 to 8 inches, and to be driven to hard bottom or until the last ten blows, under a hammer weighing 2,500 pounds with an effective fall of 10 feet, will not sink them more than 1 foot.

Contractors state that the approximate cost of the piers as now built in New York, exclusive of the random stone foundation, is from $1 to $1.25 per square foot of deck.

The method of construction above outlined involves much complicated detail which adds both to the first cost and to the cost of maintenance of the pier. The superposition of timber parts upon each other above the plane of practical permanent saturation hastens decay, while the demands laid upon the structure require that its strength shall at all times be fully maintained. This is equally true of the Philadelphia piers and all other timber constructions; and it is worthy of consideration whether ultimate economy could not be obtained by replacing the perishable part of the structure above half tide by ironwork of approved construction, thus dispensing with the use of timber in positions where its life can not be assured for more than ten or twelve years.

Undoubtedly the method of pier construction now followed in New York is greatly superior to that which has generally been employed in Philadelphia; and I know of no local conditions in our harbor which should prevent the adoption of the New York method, or some other method possessing its advantages. The difficulty presented by the excessive depth of water at some points along the revised harbor line can be overcome, as in New York, by the deposit of random material over the site of the piers. The heavy and coarse material which is to be removed by dredging from the channel in the vicinity of Port Richmond, and probably from other localities, during the progress of the harbor improvement, is admirably adapted to this purpose; and it can doubtless be obtained at much less cost than the random filling used in New York. It would, in my opinion, be better, if necessary, to postpone the advance of piers where there is hard bottom and excessive depth until the islands and shoals are removed, filling in the deep places during the progress of the work, rather than to permit the construction of crib pier heads at the new line.

The Philadelphia and New York methods of pier construction are illustrated in the accompanying sketches.

CONDITIONS FOR CONSTRUCTION.

I doubt the advisability of establishing an inflexible method of pier construction for this harbor. It seems best that some latitude should be given to adapt the construction to the requirements of different piers and different localities; but if it is desired to reconstruct the water front in the best possible manner, I am of the opinion that the following conditions should be insisted upon:

1. The future construction of cribs or other solid structures should not be permitted between the bulkhead and pier-head lines or below a level at least 2 feet above mean high water.

2. In the construction of new piers or the extension of old ones, the pile groups supporting the superstructure should be at least 10 feet apart.

In the extension of old piers, it is very desirable to remove the cribs at their outer ends; but this would involve so much expense that it is thought best not to require it.

3. The bulkhead wall should be constructed continuously through the piers, and above the plane of permanent saturation it should be built of stone or concrete.

4. No sewer should be permitted to discharge into a dock. During the progress of reconstruction, all sewers should be extended under the piers to the deep-water channel.

It is thought probable that the first two conditions will be required by future regulations of the War Department. The others can only be established by local authority.

Should the water front be reconstructed in accordance with these conditions, the city of Philadelphia would have a system of piers and docks superior to that now existing in any city of the United States, and the cost and difficulty of maintaining the necessary depth in the docks and channel would be greatly reduced.

EXECUTION OF THE PLAN OF RECONSTRUCTION.

By far the most difficult part of this inquiry still remains for consideration, viz, what is the best method to insure the execution of any adopted plan of reconstruction.

The simplest solution of the problem would be for the State, under its right of eminent domain, through the municipal authorities, or its other legally constituted agents, to gradually resume possession of the whole water front by condemning the rights of the riparian owners, reconstruct it without regard to existing structures, and lease the piers and wharves, retaining complete control of them. This method of procedure, however, is considered impracticable. It would require the expenditure of a very large sum to acquire the property and to make the new constructions, and it would doubtless be strongly resisted by private owners who prefer to retain the use and ownership of their present property.

In view of these circumstances, the following method of providing for the gradual execution of the work of reconstruction is suggested:

1. Under the provisions of the act of September 19, 1890, the War Department may establish regulations governing constructions between the bulkhead and pier-head lines. For the purposes of this report, it may be assumed that the following regulations will be thus established at an early day:

(1) All structures beyond the bulkhead line must extend to the pier-head line.

(2) No cribs or other solid structures shall be permitted between the bulkhead and pier head lines, or below a level at least 2 feet above mean high water.

(3) In the construction of new piers or the extension of old ones, the pile groups supporting the superstructure shall be at least 10 feet apart.

2. A general plan, such as is submitted in this report, should be established by law, and all new conditions or changes in existing structures should be required to conform thereto. This plan should provide for a bulkhead wall extending continuously through the piers along the whole water front, and constructed of stone or concrete masonry above the plane of permanent saturation, and it should fix the widths and locations of all piers to be hereafter built or extended. The law should authorize such changes in this plan as may be found necessary to be made, upon the recommendation of the Board of Harbor Commissioners. I suppose the city councils have power to pass such an ordinance under the act of assembly of February 2, 1854, which requires them to "authorize the construction of wharves upon a plan and scale to meet the demands of commerce." If they have not the necessary power, it should be obtained from the legislature.

3. Under existing law, the actual establishment of the port warden's lines, or any part thereof, in their new positions requires, first, an authorization of such change by the Secretary of War, and secondly, the filing of the new lines by the Board of Harbor Commissioners at the bureau of survey of the department of public works. At the present time the advance of the bulkhead line to its new position between Moore and Shackamaxon streets would be of benefit to the work of channel improvement. This line should therefore be filed and established. It will then become the arbitrary low-water line, and the city will have the power to proceed in condemnation of the property within it, in order to widen Delaware avenue. The actual widening of the avenue need not be made in any locality until the new pier-head line in that locality has been established; but the property inside the line should be acquired as soon as possible in order to guard against delay, and also to make clear to riparian owners the desirability of reconstructing their piers in accordance with the new conditions.

4. Existing piers which do not conform to the adopted plan should be permitted to remain undisturbed for the present, but their extension or reconstruction should not be allowed. Where piers are absolutely destroyed by the new plan, they should be eventually condemned, paid for, and removed by the city.

5. The pier-head lines along the water front should be established as rapidly as is justified by the progress of the channel improvement. When this has been done in any locality, permits should be granted for the extension or construction of piers in accordance with the adopted plan and the regulations of the War Department.

The method of procedure above outlined provides for the prevention of any development of the water front not in harmony with an adopted plan, but it does not insure a rate of progress in the execution of the work to conform to the progressive needs of the channel improvement. As the work proceeds, the sections along the water front will be opened for improvement in succession, beginning at the southern end of the line, and as each section is opened, it will be necessary that some of the piers therein should be reconstructed without delay. My inquiries lead me to believe that many, if not most, of the riparian owners will be unwilling to reconstruct their piers on account of the expense involved. How, then, is the necessary reconstruction to be enforced? As a possible solution of this problem, I submit the following suggestions:

1. Delaware avenue should be widened and the continuous bulkhead should be constructed along the new line, the work being executed in each section as soon as the pier-head line therein is legally established. The city should make arrangements so that there will be no delay in this work. The effect of this will be to cut off so much from many existing piers that they can not be usefully employed unless reconstructed.

2. Piers belonging to the city, the improvement of which is contemplated in the adopted plan, should be reconstructed as soon as the harbor lines of the sections in which they are located are established.

3. Power should be vested in some authority to condemn, purchase, reconstruct in accordance with the adopted plan, and lease such piers as the owners are unwilling to improve, and the necessary legislation for this purpose should be obtained as soon as possible. The object sought could perhaps best be accomplished by the organization of a dock company, under conditions and restrictions which will guarantee the management of the piers thus placed under its control so as to provide full and equal facilities for all transportation interests without favoritism or discrimination, and without profit on the capital stock beyond a reasonable rate of interest. The company should also have power to acquire other riparian property by purchase. In such an organization a proper control by the municipal government can be readily provided for. This plan is suggested by the charter of the Philadelphia Belt Line Railroad Company.

The system adopted in the harbor of Montreal suggests another method of regulation and control. The affairs of this port are under the direction of a harbor commission composed of nine members, five of whom are appointed by the Dominion cabinet and one by the city council; one is elected by the members of the Corn Exchange, one by the members of the Board of Trade, and one by the shipping interest, every owner or agent of a certain tonnage being entitled to a vote. This commission manages the affairs of the port generally, including the making and enforcing of by-laws, the construction, maintenance, and allotment of wharves, and the establishment and collection of harbor dues. There is no private ownership of wharves nor are any wharves leased to persons or companies. Allotments of wharf spaces are made from time to time, but not for longer than a year.

The Montreal system could be readily adapted to the conditions of this port, and a commission could be established in which the interests of the State, the city, and commerce could be represented, but I think the results desired can be obtained more readily and with less expense by the organization of a dock company.

If the above suggestions can be practically carried out I believe the necessities of the channel improvement will be amply provided for.

CONCLUDING REMARKS.

The preliminary plan for the increase of the landing accommodations of this port, above outlined, is submitted to the board of harbor commissioners as a basis of discussion, and with the hope and expectation that, should its essential features be adopted, it will receive great improvement in its details from those more competent than myself to investigate the problem in its legal and commercial aspect.

Some will consider that the project imposes too many restrictions upon the liberty of private owners, and it will appear to them unnecessary to demand the widening and full extension of piers, the adoption of a more expensive method of construction, and the increase of the area of the docks. They will object to placing the ownership and control of a large part of the water front in the hands of the municipality or of a corporation representing the public interest, and will maintain that the needs of commerce can best be provided for by leaving the whole matter as far as possible to private regulation. To these it may be said that some of the restrictions referred to will doubtless be imposed by the General Government, and are therefore beyond the reach of local regulation. The establishment of a plan definitely fixing the location and width of piers is not absolutely necessary for the improvement of the harbor. The law now contemplates docks at least 80 feet wide. If a maximum and minimum width for piers and an increased minimum width for docks were now established by law, the water front could be very well reconstructed without further interference with owners. But this plan would give a system of piers far inferior to that which can be obtained by a careful establishment of pier locations, and its adoption is not recommended unless the plan submitted in this report is considered impracticable.

Others will entertain the opinion that too much power is left in the hands of private owners and corporations; they will desire that possession and control of the whole or a much greater part of the water front should be acquired by the State or its agents, and they will think too much has been yielded in order to utilize existing structures. Those who advocate radical changes in construction, ownership, and control will say that the one opportunity, never to be repeated, is now at hand for Philadelphia to obtain a system of docks and piers superior to that of any other city in the country, and that it should be fully utilized without regard to cost. They will point to Antwerp and the enormous increase of its commerce as a striking example of the advantages of a complete public control and of the thorough systematic reconstruction of a harbor regardless of expense.

The plan submitted is a compromise between the conflicting views of these two classes, and it remains for the board of commissioners to decide whether in the interest of property owners less onerous conditions should be imposed, or greater sacrifices should be demanded in the interest of the public.

My acknowledgments are due to Mr. L. Y. Schermerhorn, civil engineer, formerly United States assistant engineer, who has ably assisted me in the collection of information with reference to the water front and the methods of pier construction, and in designing the bulkhead recommended in this report.

Very respectfully, your obedient servant,

C. W. Raymond,
Major, Corps of Engineers,
Consulting Engineer.

Mr. Charles Platt,
President Board of Harbor Commissioners for the City of Philadelphia, Pa.

G 3.

IMPROVEMENT OF SCHUYLKILL RIVER, PENNSYLVANIA.

This river, between its mouth and Gibson Point, in its unimproved condition, carried a channel over the bar directly at its mouth with a depth of about 10 feet at mean low water, and between the bar and Gibson Point a ruling depth of about 16 feet.

The present project proposes the formation of a channel 400 feet wide and 24 feet deep at mean low water from the mouth of the river to Girard Point, a distance of about 1 mile; from thence to Gibson Point, a farther distance of about 3 miles, a channel 20 feet deep and 250 feet wide, except at the abrupt bend at Yankee Point, where the channel width was to be increased to 300 feet; from thence to Chestnut Street Bridge, Philadelphia, a distance of about 3 miles, a channel of navigable width and 18 feet deep at mean low water. This latter reach of river has required no other improvement than the removal of about 1,000 cubic yards of rock near Locust and South streets. The channels proposed are to be obtained by dredging, and by the construction of dikes at the mouth of the river.

During the past fiscal year, under an open-market agreement with the American Dredging Company, a dangerous obstruction to navigation, consisting of about 400 cubic yards of hard material, was removed from the channel above Penrose Ferry Bridge, the work being completed on July 21, 1891.

A survey of the bar, current observations and borings on the flats on the west side of the mouth of the river, with a view to the preparation of a project for the permanent improvement of the channel across the bar, were made in December, 1891, and April, 1892. A project based upon the information thus obtained was submitted on April 12, 1892, and approved April 26, 1892. It provides for the construction of earthen and pile dikes on the west side of the mouth to prevent the dispersion of the outflowing water over the flats, concentrate the flow over the bar and provent the sliding of material into the channel. This project, with accompanying sketch, is appended hereto.

Under date of June 11, 1892, contract was entered into with Frank C. Somers, of Camden, N. J., for the construction of earthen dikes at the mouth of the river.

Under date of June 21, 1892, contract was entered into with B. G. Bailey, of Philadelphia, Pa., for the construction of a pile dike at the mouth of the river.

The improvement of the channel of the Schuylkill River by dredging was commenced in 1870, and up to the close of the past fiscal year about 1,416,000 cubic yards of material have been removed, of which about 550,000 cubic yards have been dredged in the formation of the channel near the mouth between deep water in the Delaware River and Girard Point, a distance of about 1 mile. The remaining 866,000 cubic yards have been removed from between Girard Point and Gibson Point, a distance of about 3 miles.

This work has resulted in the formation of a channel about 150 feet wide and from 18 to 20 feet deep at mean low water across the bar at the river's mouth; a channel about 250 feet wide and from 20 to 24 feet deep from inside the bar to Point Breeze, except at Yankee Point, where the width is 300 feet; and from Point Breeze to Gibson Point, a channel from 100 to 200 feet wide and from 18 to 20 feet deep. Between

Gibson Point and deep water inside the bar at the mouth the improved channel has maintained the depth to which it was dredged.

The channel over the bar, although twice dredged to a depth of 24 feet at mean low water by the removal of about 550,000 cubic yards of material, has quickly shoaled to 20 feet. The shoaling principally occurs over a portion of the channel about 1,500 feet in length, and situated directly at the river's mouth. The dikes to be constructed during the present fiscal year are designed to obviate this difficulty.

The original project proposed the improvement of the channel entirely by dredging, and the cost of the work was estimated at $485,000. It can be completed for about $47,000, making the total cost $485,750. The results of a large part of the work executed between Girard Point and the mouth having proved to be temporary, it is now necessary to improve this part of the river by means of dikes at an additional estimated cost of about $44,209. The estimated cost of the whole modified project is, therefore, $529,959, and the estimated cost of its completion is $91,209.

The present demands of commerce limit the requirement of an improved river channel to that part of the river lying between the mouth and Gibson Point, or the lower 4 miles of the river. At Girard Point are located large grain elevators and wharves. At Gibson Point and Point Breeze, which are near each other and closely related as to commercial requirements, are the large storage tanks and wharves of the petroleum oil refineries. The interests assembled at these three points cover mainly the commerce of the Schuylkill River, and both the grain and oil trade require deep-draft vessels for the proper and economical transaction of their business. Channel depths should exist which will permit the passage of vessels drawing 24 feet of water at all stages of the tide between the mouth of the river and Gibson Point.

The dredged channels which have been formed elsewhere than at the mouth have been permanent, and, if by regulating works at the mouth a 24-foot channel can be maintained, it is believed that a permanent channel of equal depth can be formed by dredging in the reach of river between the mouth and Gibson Point. Until such a channel is formed, deep-draft vessels can only be moved at high water, unless they lighter a part of their cargoes over the outer bar.

This work lies in the collection district of Philadelphia, at which, as a port of entry, there was collected during the year ending December 31, 1891, revenue to the amount of $11,121,320.14. The nearest fort and light-house are, respectively, Fort Mifflin and Schuylkill River range lights.

APPROPRIATIONS.

Act of—		Act of—	
June 11, 1870	$15,000	June 14, 1880	$40,000
March 3, 1871	10,000	March 3, 1881	40,000
June 10, 1872	40,000	August 2, 1882	25,000
March 3, 1873	40,000	July 5, 1884	25,000
June 23, 1874	20,000	August 5, 1886	18,750
March 3, 1875	20,000	August 11, 1888	25,000
August 14, 1876	20,000	September 19, 1890	45,000
June 18, 1878	30,000		
March 3, 1879	25,000	Total	438,750

EXPENDITURES.

Total to June 30, 1892	$415,031.78

Money statement.

July, 1, 1891, balance unexpended		$25, 017. 29
June 30, 1892, amount expended during fiscal year		1, 299. 07
July 1, 1892, balance unexpended		23, 718. 22
July 1, 1892, outstanding liabilities	$138. 10	
July 1, 1892, amount covered by uncompleted contracts	15, 657. 00	
		15, 795. 10
July 1, 1892, balance available		7, 923. 12
Amount appropriated by act approved July 13, 1892		46, 250. 00
Amount available for fiscal year ending June 30, 1893		54, 173. 12
Amount (estimated) required for completion of existing project		44, 959. 00
Amount that can be profitably expended in fiscal year ending June 30, 1894		44, 959. 00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for constructing two earthen dikes at the mouth of the Schuylkill River, Pennsylvania, with about 26,500 cubic yards of material dredged from the river, opened June 6, 1892, by Maj. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Price per cubic yard.	Amount.
1	American Dredging Co., Philadelphia, Pa	$8\frac{1}{2}$	$2, 252. 50
2	Frank C. Somers, Camden, N. J	$7\frac{4}{10}$	1, 961. 00
3	Atlas Dredging Co., Wilmington, Del	8	2, 120. 00

Contract (dated June 11, 1892) entered into with Frank C. Somers, in progress.

Abstract of proposals for constructing about 800 linear feet of pile dike at the mouth of Schuylkill River, Pennsylvania, and filling same with about 10,000 cubic yards of material dredged from the channel of the river opened June 6, 1892, by Maj. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Timber-work of dike (including iron work) 800 linear feet.	Earth filling of dike dredged from channel 10,000 cubic yards.	Amount.
		Per linear foot.	*Per cubic yard.*	
1	B. G. Bailey, Philadelphia, Pa	$15. 87	$0. 10	$13, 696. 00
2	Joseph P. Allen, Philadelphia, Pa	22. 43	$.09\frac{7}{8}$	18, 931. 50
3	I. H. Hathaway & Co., Philadelphia, Pa	15. 94	$.09\frac{1}{2}$	13, 702. 00
4	R. P. & J. H. Staats, New York, N. Y	21. 45	.09	18, 060. 00
5	Davis & Irvin, Philadelphia, Pa	19. 00	$.08\frac{4}{10}$	16, 040. 00
6	William A. Mundy, Philadelphia, Pa	18. 75	.10	16, 000. 00
7	Geo. C. Platt, Philadelphia, Pa	16. 88	$.08\frac{5}{10}$	14, 354. 00
8	Delaware Construction Company, Wilmington, Del	17. 69	.08	14, 952. 00
9	B. F. May & Co., Boston, Mass	23. 84	.10	20, 072. 00

Contract (dated June 21, 1892), entered into with B. G. Bailey. In progress.

COMMERCIAL STATISTICS.

The following statements of the foreign and domestic commerce of the Schuylkill River for the year ending December 31, 1891, have been compiled from the returns made to this office by shippers and consignees:

Freight movement.

Articles arriving.	Gross tons.	Value.
Asphalt	15, 100	$235,[illegible]
Chemicals	4, 066	70,[illegible]
Coal	250, 892	878,[illegible]
Clay	6, 618	19,[illegible]
Hay	1, 458	11,4[illegible]
Ice	187, 331	278,[illegible]
Iron ore	40, 179	104,[illegible]
Lumber	20, 066	135,[illegible]
Marble	5, 483	158,[illegible]
Stone, building	15, 731	1[illegible]
Stone, paving	29, 508	128,1[illegible]
Sand	219, 250	136,[illegible]
Wood	32, 328	1[illegible]
Miscellaneous	33, 301	319,[illegible]
Total	811, 331	2,784,[illegible]

Articles departing.	Gross tons.	Value.
Asphalt	2, 478	$74,[illegible]
Grain	122, 691	4,272,1[illegible]
Manure	28, 910	32,4[illegible]
Petroleum oil and products	705, 091	13,864,[illegible]
Miscellaneous	6, 435	107,[illegible]
Total	865, 605	18,351,[illegible]

Passengers arriving	30,7[illegible]
Passengers departing	31,7[illegible]
Total	61,5[illegible]

Vessel movement.

Class.	No. arriving loaded.	No. departing loaded.
Steamers	912	1,1[illegible]
Sailing vessels	580	[illegible]
Barges	1, 723	[illegible]
Canal boats	1, 405	[illegible]
Total	4, 620	2,[illegible]

APPROVED PROJECT FOR IMPROVING MOUTH OF SCHUYLKILL RIVER, PENNSYLVANIA.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., April 12, 1892.

GENERAL: I have the honor to submit the following project for the expenditure of the sum of $24,500 in the improvement of the Schuylkill River, Pennsylvania, being the balance of the appropriation made in the river and harbor act of September 19, 1890.

It is proposed to apply these funds toward the formation of a channel 400 feet wide and 24 feet deep at mean low water across the bar at the mouth of the river, as recommended in my project dated October 4, 1890, this application being, at the present time, considered most desirable in the interests of commerce.

A survey of the bar, current observations and borings on the flats on the west side of the mouth were made during June, 1891, and April, 1892. The project now submitted is based on the following facts:

1. There is now a channel having a minimum low-water depth of 24 feet, with a width varying from 250 feet to 50 feet, from Girard Point for a distance of 2,550 feet toward the mouth. This channel appears to be permanent. From this channel to deep water across the bar, a distance of about 720 feet, there is a minimum low-water depth of about 20 feet. The bar has been twice dredged to a depth of 24 feet, but has quickly shoaled.

2. The backwater coming down the river in freshets has probably a greater influence than the tidal currents in the creation and maintenance of the channel depths at the mouth. This is inferred from the following considerations:

(1) In 1819 the tidal basin of the Schuylkill was very much greater than at the present time, and two back channels above Hog and League islands entered the river just above the mouth. The silting up of the back channels, resulting in the complete closure of the Hog Island Channel and the great reduction of the League Island Channel, the construction of dikes on both sides of the river, and the rapid building up and eastward advance of Mud Island have crowded the channel over toward the eastern shore. These changes, although largely diminishing the tidal capacity, have all been followed by an increase in the depths and cross-sectional area of the low water channel.

In 1819 the minimum low-water cross section was 6,235 square feet, with a low-water depth of 9 feet. In 1887 the minimum low-water cross section was 8,890 square feet, with a low-water depth of 27 feet.

The plans of the Navy Department contemplate the closure of the channel in rear of League Island by the construction of a causeway at its western end. The extent of the changes near the mouth in low-water lines and in the line of deep water is indicated on the accompanying sketch.

(2) Neither the line of greatest ebb nor that of greatest flood velocity coincides with the thalweg of the channel.

(3) Neglecting the backwater, the mean tidal velocities at the mouth are, for the flood, 0.84 foot per second, and for the ebb, 0.57 foot per second, which are too small to produce effective scour, even in the soft material which forms the bar.

(4) The average daily flow of backwater into the channel is little less than the tidal volume, while in freshets, which are frequent and of short duration, the backwater often greatly exceeds the tidal volume.

3. The bar consists of very soft mud and sand, and results principally from two causes. The flood current carries in suspension considerable material which it deposits at the mouth of the river when its velocity is checked by the downward current of the backwater. The deposits of the flood tide constantly build up the Mud Island Flats on the west side of the mouth, and this broad, soft mud shoal, requiring a very flat channel slope, gradually slides into and shoals the channel. Water running out of the channel carries very little material in suspension, except during freshets, when the velocity is sufficient to transport most of it across the bar. It is therefore believed that the interference of

the ebb currents of the Delaware and Schuylkill rivers has very little influence in producing shoaling.

The project for the improvement of the mouth of the river prepared in this office in 1887 provides for the construction of a dike on the east side, located as shown in broken lines on the accompanying plan. It is designed to reduce the low-water width to about 600 feet and to prevent the interference of the ebb currents of the Schuylkill and Delaware. The construction of this dike will probably be found necessary in the future, but I am of the opinion that deepening over the bar can be most effectively produced by first constructing dikes on the west side, located as shown on the accompanying plan.

A high-water island, formed in 1879 and 1880 by dumping material dredged from the opposite side of the river, extends nearly across the flats opposite Girard Point. This embankment is permanent. It is proposed to build an earthern dike from the shore dike to the southern end of the island to cut off the flow between the island and the shore. It is proposed to construct another dike for a distance of about 825 feet along the eastern shore of the island, thence extending for a distance of 1,575 feet to a point in the low-water line just above the upper limit of the bar, and then turning southward and following a line near the low-water line generally parallel to the axis of the channel and extending for a farther distance of 1,800 feet. The outer end of this dike is about opposite the head of the 24-foot curve in the Delaware River. This is considered as far as it is desirable to extend this dike until its effects upon the channel have been observed. Its farther extension will probably be necessary.

These dikes will prevent the dispersion of the outflowing water over the flats, concentrate the flow over the bar, and prevent the sliding of material from Mud Island into the channel.

The dike at the southern end of the island and the dike at the northeastern end, for a distance of 2,910 feet, will be constructed of earth thrown up by a dredge. These dikes will have a bottom width of about 50 feet, a height of about 10 feet above mean low water, and slopes of about 1 on 2. These dimensions are larger than necessary, but the dredge will have to remove the material required for them in order to do the work, and therefore embankments of the size proposed will cost less than smaller ones which would have to be made by hand. The material ot the flats is admirably adapted to dike construction.

It is proposed to build the dike from the lower end of the eastern embankment for a distance of 1,700 feet by driving two rows of piles, 20 feet apart between centers, connected by tie-rods as shown in the drawings. The outer row is to be of square hemlock piles, tongued and grooved by strips spiked upon them, and driven close together. The inner row will consist of round pine piles spaced 3½ feet apart. All the piles are to be driven 12 feet below the level proposed for the bottom of the channel, or 36 feet below mean low water.

The remainder of the dike, 100 feet in length, will be built of close hemlock piles front and rear. Both portions will be filled with clay excavated from the channel.

Should it be found necessary in the future to extend this dike further into the Delaware River, where it would be much more exposed, it is proposed to construct the outer portion of round pine piles, driven 2 feet apart, in rows 15 feet apart, and to fill it with stone.

The location of the dikes and the details of their construction are shown on the accompanying drawing.

The cost of this project is estimated as follows:

2,910 linear feet of earthen dike, at $2 per linear foot	$5,820
1,700 linear feet of pile dike open in rear, at $17 per linear foot	28,900
100 linear feet of pile dike closed in rear, at $24.70 per linear foot	2,470
25,000 cubic yards earth filling in and in rear of pile dikes, at 12 cents per cubic yard	3,000
Engineering and contingencies	4,019
Total	44,209

It is proposed to apply the funds now available to the construction of the earthen dike and 800 feet of the pile dike. This will extend the construction to the point D, shown on the accompanying plan.

It is proposed to do the work by contract after advertising for proposals, such method being considered most economical and advantageous to the Government.

Very respectfully, your obedient servant,

O. W. RAYMOND,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

G 4.

IMPROVEMENT OF ICE HARBOR AT MARCUS HOOK, PENNSYLVANIA.

The harbor of Marcus Hook is situated on the right bank of the Delaware River, about 20 miles below Philadelphia. Its construction and maintenance as an ice harbor was undertaken by the General Government in 1866.

The river and harbor act of September 19, 1890, appropriated $5,000 for this work. These funds have been held for the contingency of repairs and dredging.

The work accomplished in 1889 practically carried the project for the improvement of this harbor to completion. The harbor in its present condition consists of an area of 10 acres, with a depth of from 18 to 25 feet at mean low water over about 7½ acres and from 18 to 12 feet over the remaining 2½ acres. Within this area are seven detached ice piers, consisting of stone superstructures upon timber-crib substructures, two landing or shore piers of timber with crib substructures upon pile foundations, and three groups of mooring piles placed between the detached ice piers.

The four upper ice piers were completed in 1871, and during the twenty-one years which have elapsed the wear of the ice upon the upper surfaces of the timber substructure, which is but slightly below the plane of mean low water, will necessitate, in the near future, repairs to this worn part of the substructure.

It is also probable that dredging will have to be resorted to at intervals to maintain the requisite depth of the water in the harbor.

For these objects funds should be available.

Under date of June 20, 1892, contract was entered into with Davis & Irvin, of Philadelphia, Pa., for making repairs to the two landing piers and for establishing seven groups of mooring piles to replace those which have decayed, and repairing one old group. This work will be done immediately, and is estimated to cost about $2,000.

This work is located in the collection district of Philadelphia. This is the nearest port of entry, the collections during the year ending December 31, 1891, amounting to $11,121,320.14. The nearest fort and light-house are, respectively, Fort Mifflin and Christiana Light.

APPROPRIATIONS.

Act of—		Act of—	
June 23, 1866	$5,000	August 5, 1886	$15,000
March 2, 1867	94,000	August 11, 1888	15,000
January 14, 1880	35,000	September 19, 1890	5,000
March 3, 1881	30,000		
August 2, 1882	15,000		214,000

EXPENDITURES.

Total to June 30, 1892	209,000

Money statement.

July 1, 1891, balance unexpended		$5,036.36
June 30, 1892, amount expended during fiscal year		36.36
July 1, 1892, balance unexpended		5,000.00
July 1, 1892, outstanding liabilities	$111.24	
July 1, 1892, amount covered by uncompleted contracts	1,014.34	
		1,125.58
July 1, 1892, balance available		3,874.42

Abstract of proposals for repairs to the two United States landing piers and placing of seven groups of mooring piles and repairing one existing group in the ice harbor at Marcus Hook, Pennsylvania, opened June 16, 1892, by Maj. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Approximate quantities.						
		White pine or Georgia pine timber (6,520 feet B. M.).	White oak timber (142 feet B. M.).	White oak fender and mooring piles (1,720 linear feet).	Drift bolts and spikes (752 pounds).	Chain (3,690 pounds).	Earth filling (330 cubic yards).	Amount.
		Per 1,000 feet B. M.	*Per 1,000 feet B. M.*	*Per linear foot.*	*Per pound.*	*Per pound.*	*Per cubic yard.*	
1	Davis & Irvin, Philadelphia, Pa	$37	$45	$0.30	$0.03	$0.03¼	$0.30	$1,014.34
2	Henhoeffer & Vaughan, Camden, N. J	47	47	.40	.03	.05	.75	1,455

Contract (dated June 20, 1892) entered into with Davis & Irvin. In progress.

G 5.

ICE HARBOR AT HEAD OF DELAWARE BAY, DELAWARE.

The act of August 2, 1882, contained an appropriation of $25,000 for "ice harbor at head of Delaware Bay, and for removal of sunken piers in channel back of Reedy Island, Delaware." The sum of $3,700 was expended in 1883 in removing the sunken piers at Reedy Island, and

$5,063.07 has since been expended in surveys, examinations, and office expenses.

Several plans for the formation of an ice harbor in the vicinity of Liston Point have been proposed, but the difficulties connected with the problem have been such that a satisfactory solution has not yet been reached. Those who have studied the question are unanimous in the opinion that if such an ice harbor is built it should be located in the reach of river between Reedy Island and Bombay Hook Point. This part of the river contains two localities, viz, Baker Shoal and Duck Creek Flats, the improvement of which is provided for in the project for the permanent improvement of the Delaware River, between Philadelphia and the sea, by the construction of over 11 miles of dikes. The changes which would be induced in the regimen of this part of the river by such extensive constructions would render the prior location of an ice harbor very hazardous.

The greatest need of commerce on the Delaware River is an improved ship channel between the port of Philadelphia and the sea, and, until this shall have been carried further toward accomplishment, expenditures can be applied with more advantage to channel improvements than to ice-harbor construction.

The cost of an adequate ice harbor in the vicinity of Liston Point would probably be from $400,000 to $600,000, and, after other requirements of commerce have been met, such an ice harbor would be a desirable adjunct.

APPROPRIATIONS.

Act of August 2, 1882	$25,000.00

EXPENDITURES.

Total to June 30, 1892	$8,763.07

Money statement.

July 1, 1891, balance unexpended	$16,236.93
July 1, 1892, balance unexpended	16,236.93

G 6.

CONSTRUCTION OF IRON PIER IN DELAWARE BAY, NEAR LEWES, DELAWARE.

The construction of this pier was commenced in 1871 under an appropriation of $225,000 made in the river and harbor act of July 15, 1870. By the conditions of this act the Junction and Breakwater Railroad Company, having the terminus of its line in the vicinity of the pier, was permitted "to extend their railroad upon and over said pier, and to freely use said pier in connection with their said road, subject to such regulations and charges for maintenance and repairs as the Secretary of War may adopt." The pier was completed in 1880, and expenditures since that date have been applied to the repair and maintenance of the structure. The railroad company has not yet exercised its privilege of occupying the pier.

In 1888 and 1889 the pier was injured by the collision of vessels which had been driven from their moorings behind the adjacent breakwater by severe storms. About 120 linear feet of the pier was wrecked by these collisions, involving the destruction of 17 of the wrought-iron screw piles and their attachments.

The pier was thoroughly repaired in 1891 at a cost of $7,033. These repairs are described in detail in the Annual Report of the Chief of Engineers for 1891, page 1074. Operations during the past fiscal year were confined to the compilation of office records.

A large part of the timber superstructure has been in place from ten to twelve years, and its value is greatly impaired by natural decay and deterioration. The increased weight of engines and rolling stock which has arisen since the pier was designed make the wooden superstructure too light to bear such increased loads. This, in connection with the perishable character of the superstructure, would, if the pier is ever used by the railroad company, render necessary an iron superstructure adjusted to the demands of modern railroad requirements. Such a plan, in accordance with Senate resolution of March 12, 1886, was submitted under date of April 2, 1886 (see Report of the Chief of Engineers for 1886), at an estimated cost of $93,000.

The sundry civil act of March 3, 1891, contained the following provision:

> And the Secretary of War is hereby directed to assign to the Secretary of the Treasury so much space on the Lewes iron pier as may be necessary to enable the Marine Hospital Service to establish and conduct thereon such disinfection machinery as may be required for the proper disinfection of the cargoes of vessels detained at the quarantine, and when the breakwater shall have been completed then the said pier shall be permanently assigned to the Treasury Department: *Provided*, That such occupation and use of the pier by the Marine-Hospital Service does not interfere with the engineering operations of the War Department in the completion of the breakwater improvement.

It is understood that the use of the pier as above provided will at times prohibit its use for any other purpose. The pier is of considerable value to vessels frequenting the breakwater harbor, being the only communication with the shore. It is necessary for the purposes of the Light-House Service, and its free use at all times will probably be indispensable for many years for the engineering operations of the War Department. It is not suitable for quarantine purposes, because the maximum depth at the end of the pier head is only about 21 feet at mean low water. On the west side of the pier head the depth is about 15 feet and on the east side 18 feet. Since the pier is much exposed to the effects of storms it could not be safely used in rough weather by vessels of a greater draft than about 15 feet. The great majority of vessels frequenting this harbor (including nearly all that arrive from foreign ports) could not generally be taken to this pier for the purpose of disinfection. It is therefore suggested that other arrangements be made for the requirements of the quarantine service.

The pier is in the collection district of Delaware, the nearest port of entry being Wilmington, where the amount of revenue collected during the year ending December 31, 1891, was $14,808.57. The nearest fort and light-house are, respectively, Fort Delaware and the Delaware Breakwater Light.

APPROPRIATIONS.

Act of—		Act of—	
July 15, 1870	$225,000	June 14, 1880	$10,000
June 23, 1874	10,000	March 3, 1881	10,000
March 3, 1875	25,000	August 2, 1882	13,000
March 3, 1875	15,000	April 4, 1890	10,000
August 14, 1876	30,000		
June 18, 1878	20,000		378,500
March 3, 1879	10,500		

EXPENDITURES.

Total to June 30, 1892	$378,500

Money statement.

July 1, 1891, balance unexpended	$422.45
June 30, 1892, amount expended during fiscal year	422.45

G 7.

IMPROVEMENT OF DELAWARE BREAKWATER, DELAWARE.

The Delaware Breakwater in its present condition consists of two detached structures of random stone rising about 13½ feet above high water, called respectively the breakwater and the ice-breaker. These structures are separated by a gap about 1,350 feet in length.

The present project for the improvement contemplates the closing of the gap by the construction of a connecting breakwater. The project as originally adopted in 1882 provided for a substructure of random stone having its upper surface 12 feet below mean low water, with a superstructure formed of concrete in place. The project was modified in 1890 by establishing the level of the upper surface of the substructure at 15 feet below mean low water and providing for the construction of the superstructure of concrete blocks. It was again modified in 1891, and now provides for the closing of the gap by the deposition of random stone, so as to raise the structure to a height of 14 feet above the plane of low water, with a width at top of 20 feet; the width at low water to be 40 feet and the slopes below this plane to be such as may be formed by the action of the sea; between low water and the top the slopes to be about 1 on 0.7, formed by heavy stones laid in position.

During the past fiscal year, under a contract with the Brandywine Granite Company, of Wilmington, Del., 34,022 tons of granite were deposited in the work, the contract being completed on June 1, 1892. The structure has thereby been raised to low water from the ice-breaker along the gap for a distance of about 1,006 feet. Over the remaining distance there is an average level of about 15 feet below mean low water.

The stone placed in the work during the past fiscal year was deposited over a width of 40 feet, measured transversely to the axis of the gap between established lines, so as to bring the structure to the level of low water over the entire area and permit the slopes to be formed naturally under the action of the sea.

In November, 1891, when operations were suspended for the winter season, the structure had been raised to low water over a distance of 603 feet. This portion of the work was exposed to the violent storms of last winter. During the present working season the structure has been raised to low water over a distance of 403 feet.

During the month of June, 1892, measurements were made to determine the cross sections of the work in the gap. Twenty cross sections were made at intervals of 50 feet. Above a plane from 8 to 10 feet below mean low water the average slopes are about 1 on 0.6, the exterior slope being somewhat steeper than the interior. The average slopes of the portion built last year, which have been exposed to storms, are the same as those of the portion built during the present season. Below the 10-foot plane the exterior slope on the work of 1891 is about 2 on 3, and on the work of 1892 about 1 on 1. These are true storm-developed slopes, but it is expected that they will be considerably reduced as the structure is raised above low water and as the work settles.

The total quantity of stone already deposited in the gap under the existing project is 135,735 gross tons.

In the sixty-four years which have elapsed since the Delaware Breakwater was first planned, great changes have ensued in the character, dimensions, and draft of the vssels for which protection was required and provision made. In addition to this change of requirements the deep-water area then available for anchorage behind the breakwater has been greatly reduced by shoaling.

From these continued causes a necessity has arisen for a more ample harbor of refuge whereby protection can be given to the deep-draft vessels passing this part of the Atlantic coast, and in expression of this need Congress, in the river and harbor act of September 19, 1890, provided for an examination of Delaware Bay with a view of determining the best site for a national harbor of refuge suitable for deep-draft vessels. The report of the Commission of Engineer Officers charged with this examination was submitted on January 5, 1892, and is published as Executive Document, No. 112, House of Representatives, Fifty-second Congress, first session.*

Even assuming that such a deep-water harbor of refuge will become an accomplished fact, there nevertheless remains the necessity for completing the existing project of the present breakwater, whereby increased accommodation will be given to the four or five thousand fishing vessels and smaller coasting craft which yearly use the harbor, and with advantage can continue to do so even after a more capacious harbor is built in the vicinity.

The Maritime Exchange of Philadelphia maintains a station on the breakwater, and through telegraph cables between the mainland and their station are in connection with the shipping of the harbor. The reports of the Maritime Exchange state that during the year 1891, 2,587 vessels, exclusive of tugs, fishing, and small coasting craft, anchored under the protection of the breakwater.

If funds are available it is proposed during the next fiscal year to close the gap to the plane of low water, and raise a part of the work to its full height.

This work is situated in the collection district of Delaware. Wilmington is the nearest port of entry at which the revenue collected during the year ending December 31, 1891, was $14,808.57. Fort Delaware is the nearest fort, and the Breakwater Light the nearest light-house.

APPROPRIATIONS.

Act of—		Act of—	
May 7, 1822	$22,700.00	July 7, 1838	$150,000.00
May 23, 1828	250,000.00	August 30, 1852	30,000.00
April 23, 1830	162,000.00	June 23, 1866	107,910.00
March 2, 1831	208,000.00	March 2, 1867	109,493.70
July 3, 1832	270,000.00	August 2, 1882	125,000.00
March 3, 1833	270,000.00	July 5, 1884	75,000.00
June 28, 1834	270,000.00	August 5, 1886	56,250.00
March 3, 1835	100,000.00	August 11, 1888	100,000.00
July 2, 1836	100,000.00	September 19, 1890	80,000.00
July 4, 1836 (survey)	1,000.00		
March 3, 1837	141,000.00		2,628,353.70

---

* Reprinted herein as Appendix G 12.

EXPENDITURES.

Total to June 30, 1892	$2,627,367.87
Total amount appropriated under present project to June 30, 1892	436,250.00
Total expenditures under present project to June 30, 1892	435,264.17

Money statement.

July 1, 1891, balance unexpended	$79,197.91
June 30, 1892, amount expended during fiscal year	78,212.08
July 1, 1892, balance unexpended	985.83
Amount appropriated by act approved July 13, 1892	50,000.00
Amount available for fiscal year ending June 30, 1893	50,985.83
Amount (estimated) required for completion of existing project	270,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	270,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

G 8.

IMPROVEMENT OF RANCOCAS RIVER, NEW JERSEY.

The Rancocas River discharges into the Delaware River at a point opposite the northern limits of the city of Philadelphia and about 12 miles above the foot of Market street. The project for its improvement was made in 1881, and proposed the formation of a channel from 150 to 200 feet wide with a low-water depth of 6 feet from its mouth to Centerton, a distance of about 7½ miles, and from thence to Mount Holly a 5-foot low-water channel. The estimated cost of the improvement was $81,236.

The river and harbor acts of 1881 and 1882 appropriated $20,000 for the work, and this amount was expended between 1881 and 1884 in the improvement of Coats Bar, the most marked obstruction on the lower river.

The river and harbor act of September 19, 1890, contained an appropriation of $250,000 for improving Delaware River, Pennsylvania and New Jersey, of which $10,000 "shall be expended in continuing improvement on the Rancocas River, one of the tidal tributaries of said river."

During the fiscal year of 1891, the sum of $8,802.73 was expended in the formation of a channel 6 feet deep at mean low water, and about 100 feet wide, at the following localities between the mouth and Centerton, viz: At Sharp Island, below Mill Creek, below Lime Kiln Wharf, and at Centerton; and in the removal of three wrecks lying between the railroad bridge at Delanco and the junction of the Lumbarton and Mount Holly branches of the river.

Under date of July 16, 1891, an open-market agreement was entered into with Mr. Frank C. Somers for the removal of about 8,000 cubic yards of material at 14¾ cents per cubic yard, measured in the dipper, to form a channel 25 feet wide and 4 feet deep at mean low water through the shoal areas between Centerton and Mount Holly, N. J. This work was completed on August 29, 1891, by the aggregate removal of 7,330 cubic yards of material.

The present condition of this improvement is as follows: A low-water channel 100 feet wide and 6 feet deep has been formed through the shoal areas between the mouth of the river and Centerton, and a channel 25 feet wide and 4 feet deep from Centerton to Mount Holly. By this work about three-eighths of the projected improvement has been completed, and the navigable conditions of the river have been proportionately improved.

This work is situated in the collection district of Trenton, N. J., which is the nearest port of entry, at which no revenue was collected during the year ending December 31, 1891. The nearest fort is Fort Mifflin, and the Horseshoe Lights are the nearest light-house.

APPROPRIATIONS.

Act of—	
March 3, 1881	$10,000.00
August 2, 1882	10,000.00
September 19, 1890	10,000.00
	30,000.00

EXPENDITURES.

Total to June 30, 1892	29,899.91
Carried to the surplus fund in July, 1890	100.09

Money statement.

July 1, 1891, balance unexpended	$1,197.27
June 30, 1892, amount expended during fiscal year	1,197.27
Amount appropriated by act approved July 13, 1892	5,000.00
Amount (estimated) required for completion of existing project	46,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	12,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Arrivals and departures of vessels for year ending December 31, 1891.

Kind of vessels.	Arrivals.		Departures.	
	No.	*Tons.*	*No.*	*Tons.*
Steamers	490	101,587	490	101,587
Sailing vessels	1,820	95,677	1,820	95,677
Barges	925	147,362	925	147,362
Canal boats	1,570	122,821	1,570	122,821
Total	4,805	467,447	4,805	467,447

Freight statement.

Articles.	Gross tons.	Value.	Articles.	Gross tons.	Value.
ARRIVING.			DEPARTING.		
Chemicals	1,800	$54,000	Chemicals	1,500	$45,000
Coal	14,500	58,000	Canned goods	1,500	60,000
Lime	3,600	15,000	Molding sand	132,000	200,000
Lumber	1,100	15,000	Produce	3,000	180,000
Manure	16,000	12,000	General merchandise	6,500	225,000
General marchandise	5,000	300,000			
Total	42,000	454,000	Total	144,500	710,000

G 9.

IMPROVEMENT OF ALLOWAY CREEK, NEW JERSEY.

The river and harbor act of September 19, 1890, contained an appropriation of $6,000 for the improvement of Alloway Creek, New Jersey. This was the first appropriation made for the work.

Alloway Creek discharges into the Delaware River at a point about 7 miles below Fort Delaware. Before improvement its channel had a natural mean low-water depth of more than 6 feet, extending 3½ miles above its mouth. Between this point and Quinton, a distance of 6½ miles, there were nine bars with minimum depths at mean low water of from 1.3 to 4 feet.

The project for its improvement was based upon a survey made in 1889, and proposed the improvement of the stream between Quinton, N. J., and its mouth, a distance of 10½ miles, by the formation, by dredging, of a channel 6 feet deep at mean low water and 60 feet wide from Quinton to a point about 1,000 feet above the Upper Hancock Bridge; from thence a channel of the same depth and 75 feet wide to the lower side of the bar at the Square. At a locality in the creek known as the Canal, in addition to obtaining a channel of the dimensions above named, the width of the stream is to be increased to about 150 feet between its low-water lines. At the Square the dredged channel is to be supplemented by a deflecting dike about 500 feet in length, formed of the material dredged from the adjacent bar, with its channel face protected by a riprip of stone. The estimated cost of the work was $25,000.

Under date of March 4, 1891, a contract was made with Frank C. Somers for the removal by dredging of about 25,000 cubic yards of material, at 18 cents per cubic yard, from the shoal areas at the Square, Canal, and Upper Hancock Bridge. At the close of the fiscal year ending June 30, 1891, 18,341 cubic yards had been removed under this contract. During the past fiscal year 4,893 cubic yards of material were removed, thereby completing the contract on July 14, 1891, by the aggregate removal of 23,234 cubic yards.

The work already done has produced channels 75 feet wide and 6 feet deep at mean low water through the worst bars at localities known as the Square, Canal, and Upper Hancock Bridge, whereby about one-fifth of the work projected has been accomplished and navigation much improved.

This work is situated in the collection district of Bridgeton, N. J., which is the nearest port of entry, at which no revenue was collected during the year ending December 31, 1891. The nearest fort is Fort Delaware, and the Reedy Island Light is the nearest light-house.

APPROPRIATIONS.

Act of September 19, 1890	$6,000.00

EXPENDITURES.

Total to June 30, 1892	5,599.61

Money statement.

July 1, 1891, balance unexpended	$2,532.12
June 30, 1892, amount expended during fiscal year	2,131.73
July 1, 1892, balance unexpended	400.39
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	3,400.39
Amount (estimated) required for completion of existing project	16,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	16,000.00
Submitted in compliance with requiremets of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

Arrivals and departures of vessels for year ending December 31, 1891.

Kind of vessels.	Arrivals.		Departures.	
	No.	*Tons.*	*No.*	*Tons.*
Steamers	100	10,500	100	10,500
Sailing vessels	45	4,500	45	4,500
Canal boats	15	2,250	15	2,250
Total	160	17,250	160	17,250

Freight statement.

Articles.	Gross tons.	Value.	Articles.	Gross tons.	Value.
ARRIVING.			DEPARTING.		
Coal	8,000	$27,000	Manufactured products	7,000	$350,000
Glass sand	1,500	2,250	Miscellaneous	2,000	10,000
Tin plate	800	80,000	Total	9,000	360,000
Lumber	1,400	16,000			
Soda ash	400	12,000			
Miscellaneous	3,000	6,000			
Total	15,100	143,250			

G 10.

IMPROVEMENT OF MAURICE RIVER, NEW JERSEY.

The project adopted in 1882 provided for the formation by dredging of a low-water channel 100 feet wide and 6 feet deep from a point about 4 miles below Millville to Millville Bridge, and a channel of the same width and 4 feet deep above the bridge to the head of navigation.

The project was modified in 1890 so as to provide for the extension of the 6-foot channel from Millville to the head of navigation; and again in 1892, so as to provide for the further extension of the 6-foot channel with a width of 50 feet for a distance of about 500 feet further upstream, and for slight local improvements of the channel below Millville.

During the past fiscal year, under a contract with the American Dredging Company, dated May 22, 1891, 30,840 cubic yards of material, at 19 cents per cubic yard, measured in place, were dredged from the channel, the work being completed on February 20, 1892. Under an open-market agreement with the same company, and at the same price, 6,552 cubic yards of material were removed from the channel, the work being completed on February 29, 1892.

By these operations the improvement has been fully completed in accordance with the adopted project.

The original estimated cost of the improvement was $112,000. The conditions having been very favorable, it has been completed at a total cost of $43,000.

At the time of adoption of the project the channel of this river had a natural mean low-water depth of from 10 to 40 feet from the bay to a point 4 miles below Millville, a distance of about 20 miles, except upon the bar at the mouth, where the depth was 5 feet. The remainder of the river to the head of navigation, a distance of about 4½ miles, was quite shoal, with a minimum depth of 2 feet at mean low water. As the result of the improvement there is now a channel having a minimum low-water depth of 6 feet from the bar to the head of navigation, and the river is navigable at all stages of the tide.

This work is situated in the collection district of Bridgeton, N. J., which is the nearest port of entry, at which no revenue was collected during the year ending December 31, 1891. The nearest fort is Fort Delaware, and the Maurice River Light is the nearest light-house.

APPROPRIATIONS.

Act of—	
August 2, 1882	$3,000
July 5, 1884	17,000
August 5, 1886	5,000
August 11, 1888	10,000
September 19, 1890	8,000
	43,000

EXPENDITURES.

Total to June 30, 1892	43,000

Money statement.

July 1, 1891, balance unexpended	$8,083.77
June 30, 1892, amount expended during fiscal year	8,083.77

COMMERCIAL STATISTICS.

Arrivals and departures of vessels for year ending December 31, 1891.

Kind of vessels.	Arrivals loaded.		Departures loaded.	
	No.	*Tons.*	*No.*	*Tons.*
Steamers	40	4,000	60	6,000
Sailing vessels	5,110	126,984	225	27,000
Barges	15	1,200	21	1,680
Total	5,155	132,184	306	34,680

Freight statement.

Articles.	Gross tons.	Value.	Articles.	Gross tons.	Value.
ARRIVING.			DEPARTING.		
Brick	3,572	$12,800	Clay	5,000	$12,500
Coal	10,000	40,000	Glass sand	36,500	63,875
Cotton	400	80,000	Gravel	35,000	43,750
Grain	2,994	95,100	Iron pipe	16,600	498,000
Glass sand	3,000	9,000	Sand	600	900
Ice	1,500	4,500	Wood	3,125	10.000
Iron, pig	10,500	189,000	Total	96,825	629,025
Lumber	6,375	38,250			
Oysters	91,714	1,284,000			
Oyster shells	3,000	3,862			
Stone, building	3,000	4,125			
Hay, salt	2,500	15,000			
Total	138,555	1,775,637			

G II.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

During the past fiscal year three wrecks have been removed under the authority of the act of Congress approved June 14, 1880.

In April, 1891, the scow *Paddy Ryan* was sunk in the Rancocas River, New Jersey, near the railroad drawbridge at Delanco. The wreck being a dangerous obstruction to all vessels passing through the draw its removal was recommended. Under date of June 24, 1891, a contract was made with Enoch Townsend for the removal of the wreck for the sum of $345. The work was completed on July 8, 1891.

In September, 1882, the iron steamer *Nuphar* was sunk on the outer bar of Townsend Inlet, New Jersey. The wreck being a dangerous obstruction to vessels passing through the inlet its removal was recomended. Under date of December 2, 1891, a contract was made with Enoch Townsend for the removal of the wreck for the sum of $4,875. The work was completed on April 7, 1892.

In December, 1891, the canal boat *Agatha Brady* was sunk in the Delaware River opposite Fairmount Avenue Wharf, city of Philadelphia, in about 24 feet of water, just eastward of the channel of the river. The wreck being a dangerous obstruction to navigation its removal was recommended. Under date of June 10, 1892, a contract was entered into with the American Dredging Company for the removal of the wreck for the sum of $425. The work was completed on June 17, 1892.

Abstract of proposals for removal of the wreck of the steamship Nuphar, lying on the outer bar of Townsend Inlet, N. J., opened Novembev 23, 1891, by Maj. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Price.
1	B. G. Bailey, Atlantic City, N. J	$18,900
2	Wm. E. Chapman, New York, N. Y	8,490
3	Atlantic and Gulf Wrecking Co., Somers Point, N. J	9,700
4	Enoch Townsend, Somers Point, N. J	4,875
5	Charles W. Johnston, Lewes, Del	9,800

Contract (dated December 2, 1891) entered into with Enoch Townsend.

Abstract of proposals for removal of the wreck of the canalboat Agatha Brady, lying in the Delaware River opposite Fairmount Avenue Wharf, city of Philadelphia, opened June 6, 1892, by Maj. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Price.
1	Frank C. Somers, Camden, N. J	$497
2	American Dredging Co., Philadelphia, Pa	425
3	Duncan A. Johnston, Camden, N. J	575
4	Enoch Townsend, Somers Point, N. J	685
5	Charles W. Johnston, Lewes, Del	950

Contract (dated June 10, 1892) with the American Dredging Company.

G 12.

REPORT OF COMMISSION OF ENGINEER OFFICERS UPON LOCATION AND PLAN FOR HARBOR OF REFUGE FOR DEEP-DRAFT VESSELS NEAR MOUTH OF DELAWARE BAY.

[Printed in House Ex. Doc. No. 112, Fifty-second Congress, first session.]

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., January 5, 1892.

GENERAL: The Commission of Engineer Officers constituted by paragraph 2, Special Orders No. 66, Headquarters, Corps of Engineers, United States Army, September 30, 1890, to examine and report upon a proposed national harbor of refuge for deep-draft vessels near the mouth of Delaware Bay, under the provisions of the river and harbor act of September 19, 1890, has the honor to submit the following report:

The provisions of law above referred to are as follows:

> SEC. 17. That the Secretary of War is hereby directed, at his discretion, to cause examinations or surveys, or both, to be made, and the estimated cost of improvement to be estimated, at the following localities, to wit:
>
> * * * * * * *
>
> Delaware Bay, with a view of determining the best site near the mouth of the same for a national harbor of refuge suitable for deep-draft vessels. The examination to be made by a commission of three engineer officers, who will make the examination and submit to the Secretary of War a report thereon, with a project and estimate of cost of construction of such a harbor of refuge.

The Commission met at the United States Engineer Office in Philadelphia on December 11, 1890, and after a careful study of the charts of Delaware Bay and an examination of the various reports upon the existing harbor and its vicinity, submitted a preliminary report on the same date.* The views of the Commission are fully expressed by the following extracts from this report.

> The necessity of a harbor of refuge in this vicinity was early recognized; and it was provided for by the construction of the existing harbor at Lewes, Del., which was projected by a commission of distinguished officers in 1828. Notwithstanding the fact that the plans for this harbor have not been fully carried out, it has been of immense benefit to commerce, and numerous reports establish its great value and its national character. At the present time this harbor is inadequate to the needs of commerce, and it will continue to be so after the work of breakwater extension now in progress has been completed.
>
> Since this harbor was projected the number of vessels requiring its shelter has enormously increased. Its anchorage area is far too limited, and its low-water depth of only about 16 feet prohibits its use by the deep-draft vessels of the present day. It will always be of value for the protection of the numerous small vessels passing along the coast in this vicinity, but no extension or improvement can adapt it to the uses of the modern deep-draft vessels.
>
> The Commission is not now prepared to submit statistics giving the number and draft of vessels navigating the ocean along this part of the coast, to which a deep-water harbor of refuge would be of value, but it is not doubted that such a harbor

---

*Printed as Appendix G 22, Annual Report, Chief of Engineers, 1891, page 1120.

would be of great benefit to commerce; and its construction would be justified if a suitable location can be found where it can be formed at reasonable expense.

The act of Congress as to this harbor of refuge requires it to be one for deep-draft vessels. The great draft of such vessels of to-day, and the up and down motion, and swing of such vessels under heavy wave action, make ample depth and anchorage capacity essential features of the desired harbor of refuge in this bay. It should be near the main channel and easily accessible at all times and in all weather, and should shelter vessels from the prevailing storm winds, blowing from east to northwest round by the north, and protect them from floating ice descending from the northwest and north.

The information at present in the possession of the Commission points to the deep-water pocket on the west side of the main ship channel covered by the shoal, known as the Shears, as the best one for satisfying the required conditions. This position is now a favorite anchorage, is very conveniently located for communication with the shore, the existing harbor, and the channel, and is believed to have the approval of the maritime interests.

A definite decision upon this question should, in the opinion of the Commission, be postponed until after a detailed survey which shall show the present condition (both as to depth and area) of the above-mentioned deep-water pocket, and which shall also show the recent changes in the bottom of the bay in this neighborhood.

Under the authority of the Department, the Commission had a detailed survey made of the Shears and the adjacent deep-water spaces. Owing to the exposure of the locality, to very unfavorable weather, and to lack of sufficient funds to prosecute the work to the best advantage, the survey was made with great difficulty; and, although commenced as soon as practicable and prosecuted as diligently as allowed by circumstances, the fieldwork of the survey was not completed until late in the summer, during September, 1891. The survey covers an area of about 6 square miles, and contains about 7,000 soundings, about 3,500 of which were located by triangulation. The principal results are shown upon the map accompanying this report.* No borings were made, but all information so far collected indicates that the bottom consists of sand and mud, and furnishes a suitable foundation for breakwater construction, and a good holding ground for ships.

Comparisons of this survey with the engineer survey of 1881 and with the coast survey chart of 1843 show no changes in the bottom of the bay around the east fork of the Shears and nothing but unimportant changes at and around its west fork.

The Commission is of the opinion that the area occupied by the Shears and adjacent waters is "the best site near the mouth of Delaware Bay for a national harbor of refuge suitable for deep-draft vessels."

It is proposed to form the harbor by the construction of a breakwater located upon the line of least depth along the eastern branch of the Shears, as shown upon the accompanying map.

The heaviest winds and seas in this locality are from the east-northeast. The breakwater is extended as far towards the northwest as in the opinion of the Commission is necessary for sufficient protection against the heavy northeast winds and seas coming around the end of Cape May. From this point it extends in a southeast direction for a distance of 1 mile, and then, for a distance of half a mile, runs in a direction towards and tangent to Cape Henlopen; being extended as far towards the south as is thought best at present, considering the desirability of allowing a free access to the proposed harbor. Against the heaviest storms, those from the east-northeast, the projected harbor has a protected anchorage area of 552 acres, with a minimum low-water depth of 30 feet; and an additional area of 237 acres, with a minimum low-water depth of 24 feet; this being sufficient to give free and good anchorage to more than a thousand vessels at once. As the proposed breakwater lies in the direction of the ebb currents, its construction is not liable to cause any undesirable changes in the adjacent shoals.

---

* Not reprinted. Printed in House Ex. Doc. No. 112, Fifty-second Congress, first session.

The Commission is of the opinion that it will be unnecessary to construct a breakwater to cover the anchorage from northwesterly winds and seas, but protection from ice descending the bay during the ebb tide must be provided for. This can be accomplished by the construction of a row of ice piers across the upper end of the harbor, as shown on the accompanying map.

One of the important characteristics of a harbor of refuge is that it be capable of defense. While this Commission is not charged with the duty of arranging for the defense of the harbor of refuge now under consideration, it seems not inappropriate to say that the locality of the protecting ice piers could with unusual advatage be utilized for purposes of defense in connection with the objects of the harbor of refuge.

After full consideration of all the recent methods employed in breakwater construction, including the use of concrete in place, in bags, and in blocks of very large dimensions, the Commission is of the opinion that the method best adapted to this locality is the formation of a mound to the level of low water by the deposit of random stone and the construction of a superstructure thereon by the erection of outer and inner walls of very heavy stones, the interior space to be filled with rubble. This method of construction is in accord with the experience gained from past work on the old breakwaters in this vicinity. For the purposes of this project and estimate the Commission has assumed the dimensions adopted for the work now in progress for closing the gap between the breakwater and ice-breaker of the existing harbor. The cross section is shown on the accompanying map.

In determining the quantity of stone required it is assumed that each cubic yard of settled enrockment will contain 1.25 gross tons, this relation being the result of the latest experience at this particular work.

The cost of the construction of the proposed harbor is estimated as follows, being based upon the assumption that funds will be supplied as fast as they can be economically expended:

North face:		
Substructure, 472,191 tons, at $3		$1,416,573
Superstructure, 103,420 tons, at $4		413,680
		1,830,253
South face:		
Substructure, 608,760 tons, at $3	$1,826,280	
Superstructure, 51,710 tons, at $4	206,840	
		2,033,120
Total cost of breakwater		3,863,373
Ice piers:		
Ten ice piers, at $37,750		377,500
		4,240,873
Engineering and contingencies		424,127
		4,665,000

Respectfully submitted.

Wm. P. Craighill,
Colonel, Corps of Engineers.
C. W. Raymond,
Major, Corps of Engineers.
W. H. Bixby,
Captain of Engineers.

Brig. Gen. Thomas L. Casay,
Chief of Engineers, U. S. A.

APPENDIX H.

IMPROVEMENT OF RIVERS AND HARBORS IN DELAWARE, AND ON EASTERN SHORE OF CHESAPEAKE BAY, MARYLAND AND VIRGINIA, AND OF INLAND WATER WAY FROM CHINCOTEAGUE BAY, VIRGINIA, TO DELAWARE BAY, DELAWARE.

REPORT OF WILLIAM F. SMITH, UNITED STATES AGENT, MAJOR OF ENGINEERS, U. S. ARMY, RETIRED, IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Wilmington Harbor, Delaware.
2. Ice harbor at New Castle, Del.
3. Appoquinnimink River, Delaware.
4. Smyrna River, Delaware.
5. Mispillion Creek, Delaware.
6. Broadkiln River, Delaware.
7. Inland water way from Chincoteague Bay, Virginia, to Delaware Bay at or near Lewes, Delaware.
8. Susquehanna River above and below Havre de Grace, Md.
9. Northeast River, Maryland.
10. Elk River, Maryland.
11. Fairlee Creek, Maryland.
12. Chester River, Maryland, from Crumpton to Jones Landing.
13. Choptank River, Maryland.
14. Cambridge Harbor, Maryland.
15. Wicomico River, Maryland.
16. Manokin River, Maryland.
17. Onancock Harbor, Virginia.
18. Harbor at Cape Charles City, Virginia, and approaches by Cheuton (Cherrystone) Inlet.
19. Removing sunken vessels or craft obstructing or endangering navigation.

EXAMINATIONS AND SURVEYS.

20. Murderkill River, Delaware.
21. Mispillion River, Delaware.
22. Susquehanna River above Havre de Grace, Md.
23. Rock Hall Harbor, Maryland.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., July 9, 1892.

GENERAL: I have the honor to transmit herewith the annual report for the works of river and harbor improvement in my charge for the fiscal year ending June 30, 1892.

I was ably assisted during the year by Mr. A. Stierle, assistant engineer, in the prosecution of these works.

Very respectfully, your obedient servant,

WM. F. SMITH,
United States Agent.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

H I.

IMPROVEMENT OF WILMINGTON HARBOR, DELAWARE.

At the beginning of the fiscal year the contract with the Atlas Dredging Company, of Wilmington, Del., was still in force, operations having been begun on February 11, 1891. The contract was completed on August 14, 1891. The amount of material removed during the fiscal year was 67,645 cubic yards, which increased the length of the channel previously dredged 1,000 feet. The total amount removed under the contract was 302,985 cubic yards, resulting in an improved channel, 15 feet deep at mean low water and 150 feet wide at the bottom, from the Shellpot railroad bridge to the Pusey & Jones shipyard, a distance of 6,200 feet. The dredged material was mud and sand, principally the former, and was deposited in a cove of the Delaware River below Edgemoor.

The approved project of improvement is for a 15-foot low-water channel, 150 feet wide from the mouth of the Christiana River to the Rolling Mill wharf (4,750 feet above the outer end of the jetty), 100 feet wide from this wharf to the Delaware and Western Railroad bridge, and 75 feet wide from this bridge to the pulp works; also for a channel, 12 feet deep and 50 feet wide from the pulp works to the Delaware Railroad bridge, and for the construction of a jetty 1,740 feet long on the north side of the mouth of the river. The Board of Engineers, which recommended these improvements in 1881 estimated the total cost at $175,551. The construction of the jetty and dredging operations were begun the following year. On page 662, Annual Report of the Chief of Engineers for 1883, a revised estimate is given for the completion of the above project. This estimate increased the channel width of the whole section from the Rolling Mill wharf to the pulp works to 150 feet, and did not include the 12-foot channel previously estimated for from the pulp works to the Delaware Railroad bridge, the total cost being given at $191,384, exclusive of the expense of building the jetty, which was then nearly completed. A modification of the plan of the jetty was made and approved in 1884, providing for an additional height of 4 feet and an extension of 322 feet in length. The former work was done the following year.

Up to the year 1871 the General Government had at various times expended $32,356 in the improvement of Christiana River or Wilmington Harbor. Between the years 1871 and 1881 improvements were continued under a project for a 12-foot low-water channel from 100 to 200 feet wide, and $83,500 had been expended when the project was completed in the latter year. Under the project adopted in 1881 $201,404.66 have been expended, making a grand total of $317,260.66 at the close of the fiscal year ending June 30, 1892.

The commission on the improvement of this harbor, appointed by the Secretary of War in accordance with a provision of the river and harbor act of September 19, 1890, have made their report and plan for a permanent improvement of Wilmington Harbor. The report is printed on pages 1138–1159, Annual Report of the Chief of Engineers for 1891.

Wilmington is a port of entry and in the collection district of Delaware. The amount of revenue collected during the fiscal year ending June 30, 1892, is $10,533.75.

AMOUNTS APPROPRIATED.

By act approved—	
July 14, 1836	$15,000
March 3, 1837	8,000
July 7, 1838	9,356
July 11, 1870	15,000
June 10, 1872	10,000
March 3, 1873	6,000
June 23, 1874	6,000
March 3, 1875	10,000
August 14, 1876	16,000
June 18, 1878	7,000
By act approved—	
March 3, 1879	$3,500
June 14, 1880	10,000
March 3, 1881	50,000
By act passed August 2, 1882	50,000
By act approved—	
July 5, 1884	25,000
August 5, 1886	18,750
By act of August 11, 1888	30,000
By act approved September 19, 1890	30,000

Of the above the sum of $2,411.22 has been carried to the surplus fund of the Treasury.

Money statement.

July 1, 1891, balance unexpended	$15,692.17
June 30, 1892, amount expended during fiscal year	13,346.83
July 1, 1892, balance unexpended	2,345.34
Amount appropriated by act approved July 13, 1892	40,000.00
Amount available for fiscal year ending June 30, 1893	42,345.34
Amount (estimated) required for completion of existing project	47,634.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	47,634.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Maritime business of Wilmington, Del., for the year ending December 31, 1891.

[Data kindly furnished by Mr. E. Kershaw, harbor master, Warner's Propeller Line, Bush's Wilmington and Philadelphia Steam Freight Line, the Wilmington Steamboat Company, and New Jersey and Wilmington Ferry Company.]

Class.	Tons.	Value.
Raw products	404,630	$2,019,670
Manufactured products	123,873	13,577,847
Agricultural products	7,400	363,800
General merchandise	99,673	4,983,650
Total	635,076	20,944,967

Vessels trading in Wilmington Harbor, Delaware.

Class.	No.	Aggregate tonnage.	Draft.	Trips.
			Feet.	
Steamers	4	956	4½ to 8½	Twice a day each.
Freight steamers	6	1,517	7 8	Daily and weekly.
Tugboats	5	200	6 9	Constantly.
Schooners	15	4,540	4 12	Do.
Barges	3	575	4	Daily.

Vessels entered engaged in foreign trade, 8; tonnage, 4,630. Vessels cleared engaged in foreign trade, 8; tonnage, 4,323. Number of passengers carried to and from Wilmington, 304,377.

Vessels built and repaired at Wilmington, Del., during the year ending December 31, 1891.

Class of vessel.	No.	Registered total tonnage.	Draft of largest vessel when leaving shipyard.	Calculated maximum draft when loaded of largest vessel built.
Built:			*Feet.*	*Feet.*
Passenger steamers	1	517		
Freight steamers	7	2,331	7	
Passenger and freight steamers	13	10,550	13½	29
Towing steamers	2	127		
Schooners	2	1,101	9	18
Sloops	1	9		
Scows and barges	2	750	3	
Repaired:				
Steamers	62	24,362		
Sail vessels, barges, and scows	61	14,017		

These data were furnished by the following shipbuilding firms: The Harlan & Hollingsworth Company, the Jackson & Sharp Company, the Pusey & Jones Company, and Enoch Moore.

H 2.

ICE HARBOR AT NEW CASTLE, DELAWARE.

At the beginning of the past fiscal year plans had been submitted for the construction of a new ice pier, to be called "O," and for the removal of old Pier H. The plans were approved early in July, 1891, and after public advertisement proposals were received and opened on September 21 and a contract made September 29, 1891, with the lowest bidder, the Delaware Construction Company, of Wilmington, Del., at the stipulated sum of $9,500. The contractor began operations on October 1 and completed the contract on December 28, 1891, the removal of Pier H having been carried on during the time the new pier was being put in position. The past winter was not severe enough to test, as yet, the efficiency of the latter during running ice in the river, as the harbor was filled on two occasions only with ice of inconsiderable thickness.

The new pier differs in construction in many important points from those previously erected in the ice harbors of the Delaware River. It consists of a crib substructure 27 feet high, filled with stone and an iron shell superstructure 15 feet high, filled with large stone and concrete. The top of the pier extends to the height of 12 feet above mean low water and the bottom rests upon a gravel stratum 30 feet below low water. To reach this depth it was necessary to excavate through a stratum of mud 15 feet deep. In plan the pier is four-sided, lozenge-shaped, with a considerable batter from the bottom up, and its longitudinal axis, which measures 52½ feet on the bottom and 32¾ feet on the top of the structure, is in a direction parallel with the prevailing currents. The extreme widths normal to this direction are on the bottom and top, respectively, 33½ and 20 feet.

All the piers built during the past twenty years in Marcus Hook and New Castle harbors for protection against ice are alike in kind and form and consist of wooden cribs filled with stone for a foundation to the height of low-water level, and of a cut-stone superstructure, partly filled with rubble, extending to from 4 to 6 feet above the plane of common high water. In plan they present a six-sided elongated figure. The piers at Marcus Hook, eight in number, which are somewhat smaller in general dimensions, have cost from $10,247 to $20,000 apiece. The four piers built at New Castle during the same period average higher in cost, the lowest being $17,597 and the highest $22,949. In several cases two working seasons were necessary to complete one of the above ice piers.

Pier O, recently built at New Castle, has been much reduced in cubical contents and consequently has less weight as compared with the old-style piers. It is nevertheless calculated to possess sufficient strength and stability to withstand the heaviest shocks of ice or vessels. Its economy in and rapidity of construction are also features which recommend a more extensive application of this form for ice piers.

The project for the establishment of an ice harbor at New Castle dates back to Colonial times and was suggested by the necessity of providing a place of refuge for vessels during prevalence of ice in the Delaware River. Since the ice harbor at Reedy Island, 10 miles farther down the river, has become useless from decay and lack of water, this harbor is now the first one vessels reach in coming up the bay. The number of vessels seeking refuge during winter is very great, and the enlargement of the harbor is only a question of time. Attention was called in last year's report to the practicability of materially enlarging the area of the harbor if an additional pier were constructed on the 30-foot contour at the point of intersection of two lines prolonged over piers K and M, and L and N, respectively.

New Castle is in the collection district of Delaware. Wilmington is the nearest port of entry, and the amount of revenue collected there during the fiscal year ending June 30, 1892, is $10,533.75.

AMOUNTS APPROPRIATED.

By act approved—		By act approved—	
May 20, 1826	$25,000.00	August 14, 1876	$12,000.00
March 2, 1829	18,895.99	June 18, 1878	10,000.00
July 2, 1836	25,000.00	March 3, 1879	5,500.00
March 3, 1837	10,000.00	June 14, 1880	3,000.00
July 7, 1838	11,573.00	March 3, 1881	20,000.00
August 30, 1852	15,000.00	July 5, 1884	2,000.00
July 15, 1870	2,500.00	August 5, 1886	5,000.00
June 10, 1872	27,000.00	By act of August 11, 1888	7,500.00
March 3, 1873	20,000.00	By act approved September 19, 1890	8,100.00
June 27, 1874	10,000.00		
March 3, 1875	20,000.00		

Of the above the sum of $18,285.65 has been carried to the surplus fund of the Treasury.

Money statement.

July 1, 1891, balance unexpended	$15,190.79
June 30, 1892, amount expended during fiscal year	11,343.99
July 1, 1892, balance unexpended	3,846.80

Abstract of proposals opened September 21, 1891, by Wm. F. Smith, U. S. agent, for construction of new ice pier and removal of old Pier H in New Castle Harbor, Delaware.

No.	Name and address of bidder.	Price for construction of new, and removal of old pier.	Amount available.
1	Henry M. Doremus, Newark, N. J	$10,990	$12,000
2	Ira Lunt, New Castle, Del	9,913	....
3	I. H. Hathaway, Philadelphia, Pa	10,496	....
4	Henhoeffer & Vaughn, Wilmington, Del	10,300	....
5	Delaware Construction Co., Wilmington, Del	9,500	....

Contract (dated September 29; 1891) with Delaware Construction Company.

COMMERCIAL STATISTICS.

Receipts.

Class.	Tons.	Value.
Coal	993	$4,965
Iron supplies and fire brick	2,899	195,340
General merchandise	3,592	179,600
Total	7,484	379,905

The above were received over the wharf of the Wilmington and Northern Railroad Company at New Castle, Del.

H 3.

IMPROVEMENT OF APPOQUIN(N)IMINK RIVER, DELAWARE.

There were no operations during the fiscal year ending June 30, 1892. The appropriation of $5,000 made September 19, 1890, was expended during the fiscal year ending June 30, 1891, in dredging a channel of the dimensions provided in the project for a length of 1,975 feet below Odessa Bridge.

The approved project is based upon a survey made in 1889, and is for a channel 8 feet deep at mean low water with a width of 80 feet from the bridge at Odessa to near Townsend's Wharf, a distance of 3¼ miles, and a width of 100 feet from this wharf to the mouth, a distance of 5 miles. The estimated cost of the improvement is $39,963.

There is a bar at the junction with the Delaware River which is navigable only at high tide, which rises here, on an average, about 6 feet. The rise and fall of the tide at the head of navigation is 3.2 feet. The amount asked for will be expended in accordance with the approved project.

This work is in the collection district of Delaware. Wilmington is the nearest port of entry, and the amount of revenue collected there during the fiscal year ending June 30, 1892, is $10,533.75.

AMOUNT APPROPRIATED.

By act approved September 19, 1890 .... $5,000

Money statement.

July 1, 1891, balance unexpended	$36.28
July 1, 1892, balance unexpended	36.28
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal ending June 30, 1893	5,036.28
Amount (estimated) required for completion of existing project	29,963.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts:		
Coal and phosphate material	4,625	$83,125
Tin plate	145	16,200
General merchandise	4,000	400,000
Total	8,770	499,325
Shipments:		
Canned goods and fertilizers	3,040	161,000
Fruit, grain, cattle, poultry, hay, etc	6,266	527,550
General merchandise	6,000	240,000
Total	15,306	928,550
Total receipts and shipments	23,076	1,427,875

Vessels trading in Appoquin(n)imink River, Delaware.

Class.	No.	Aggregate tonnage.	Draft. *Feet.*	Trips.
Steamers	1	100	7	Triweekly.
Schooners	2	160	6¼	150 to 200 trips each.
Barges	2	....	6 to 9	136 trips.

The above statistics were furnished by the Lord & Polk Chemical Company, of Odessa, Del.

H 4.

IMPROVEMENT OF SMYRNA RIVER, DELAWARE.

At the beginning of the past fiscal year the contract with the National Dredging Company, of Wilmington, Del., for dredging, was still in force, operations having been begun on May 29, 1891. The contract was completed on August 10, 1891, 12,000 cubic yards of material having been removed since July 1, resulting in giving an additional mile of improved channel connected with that made the previous fiscal year. Under the contract 25,139 cubic yards of material were removed from the river between Smyrna Landing and Eagle Nest Landing, the length of the improved channel being nearly 3 miles, with a width of 40 feet, which at several sharp turns was increased to about 70 feet. The depth made was 6½ feet at mean low water. The material removed, which was principally sand and clay, was deposited upon the banks of the river.

A project for the improvement of Smyrna River, then Duck Creek, was made in 1878, recommending a 6-foot low-water channel, 40 feet wide within the stream, and a channel 100 feet wide and 8 feet deep at the entrance. It appears that the improvement at the mouth was subsequently held to be of greater importance than that of the creek, on account, as then stated, of the evident desirability of harbors of refuge for the numerous small vessels engaged in fishing, oystering, and freighting that navigate Delaware Bay, for which Duck Creek Entrance furnished superior natural advantages. Between the years 1880 and 1882 appropriations aggregating $10,000 were expended by special direction of Congress in dredging the bar at the mouth. A channel nearly 100 feet wide and 8 feet deep at low water was made, but soon thereafter filled up again to such an unexpected extent that no further appropriation for dredging at that point was recommended by the officer in charge unless protective works were first provided for.

The existing project is based upon a survey made in 1887 and is for a 7-foot low-water channel 60 feet wide from Smyrna Landing to the mouth and 100 feet wide across the bar, the latter channel to be protected by a stone jetty, the estimated cost being $90,698.40. Operations thus far have been confined to dredging within the stream, and up to the close of the fiscal year ending June 30, 1891, $12,536.35 had been expended, giving an improved channel nowhere less than 40 feet wide and 6½ feet deep from Smyrna Landing to Brick Store Wharf, a section of the river 3 miles long.

During the fiscal year ending June 30, 1892, $4,607.61 were expended in continuing operations as above stated. Within the upper 5 miles of the river, from Smyrna Landing to Eagle Nest Landing, the minimum width of the channel is 40 feet and the least depth 6½ feet at the points where dredging was done. There are portions in the section named where the natural depth and width considerably exceed the above dimensions.

The improved channel has been the means of bringing navigation by steam 2 miles nearer the town of Smyrna, and has in consequence contributed towards a reduction in freight rates and in the hauling time to and from the town. Shipments by water were unusually heavy during the past summer, and it is stated that steamers of larger carrying capacity will be put on the line as soon as the full projected depth and width have been made in the channel.

The amount asked for, if appropriated, will be expended in dredging in pursuance of the project now in force.

This work is in the collection district of Delaware. Wilmington is the nearest port of entry, and the amount of revenue collected there during the fiscal year ending June 30, 1892, is $10,533.75.

AMOUNTS APPROPRIATED.

By act approved—	
June 14, 1880	$5,000
March 3, 1881	3,000
By act passed August 2, 1882	2,000
By act of August 11, 1888	10,000
By act approved September 19, 1890	5,000

Money statement.

July 1, 1891, balance unexpended	$4,697.28
June 30, 1892, amount expended during fiscal year	4,607.61
July 1, 1892, balance unexpended	89.67
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	3,089.67
Amount (estimated) required for completion of existing project	19,365.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts:		
Bone, coal, iron, phosphate rock, and ice	7,000	$91,000
Grain, truck, hay, potatoes, live stock, etc	22,029	293,050
Chemicals, canned goods, fertilizers, etc	6,973	207,000
General merchandise	10,000	400,000
Total	46,002	991,050
Shipments:		
Cord wood, railroad ties, and ship timber	70,096	209,000
Baskets, bricks, canned goods, crates, etc	98,471	949,000
Fruit, truck, grain, hay, poultry, cattle, etc	23,515	1,159,350
General merchandise	5,000	200,000
Total	197,082	2,517,350
Total receipts and shipments	243,084	3,508,400

Vessels trading in Smyrna River, Delaware.

Class.	No.	Aggregate tonnage.	Draft.	Trips.
			Feet.	
Steamers	3	460	5 to 6	Daily three months and triweekly balance of year.
Tugboats	4		6	Charter.
Schooners	4	200	4 to 5	Do.
Barges	1	200	4	Do.

The above statistics were furnished by Mr. A. E. Jardine, secretary of the Philadelphia and Smyrna Transportation Company.

H 5.

IMPROVEMENT OF MISPILLION CREEK, DELAWARE.

There were no operations during the fiscal year ending June 30, 1892, for want of funds. A survey of the mouth of this stream, ordered September 19, 1890, was made in the fall of 1891 and a report submitted on November 5, 1891.

The improvement began in 1879, the project being for a 6-foot low-water channel, 40 feet wide, from Milford, the head of navigation, to the mouth. Up to the close of the fiscal year ending June 30, 1889, the sum of $17,000 had been expended, with the result of a clear channel of the required dimensions extending from Milford to Flat Reach Shoal, a distance of 12 miles. This shoal remains to be dredged to complete the project.

Mispillion Creek is in the collection district of Delaware. Wilmington is the nearest port of entry, at which the amount of revenue collected during the fiscal year ending June 30, 1892, is $10,533.75.

AMOUNTS APPROPRIATED.

By act approved—	
March 3, 1879	$3,000
June 14, 1880	4,000
March 3, 1881	3,500
By act passed August 2, 1882	3,000
By act of August 11, 1888	3,500

Money statement.

Amount appropriated by act approved July 13, 1892	$12,000.00
Amount (estimated) required for completion of existing project	14,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts:		
Bone, coal, phosphate rock, iron, ice, etc	21,398	$235,080
Chemicals, fertilizers, flour, lumber, tin plate	13,602	293,375
Hay	225	4,500
General merchandise	2,450	49,000
Total	37,675	581,955
Shipments:		
Cord wood, piles, railroad ties, etc	22,989	156,375
Baskets, crates, canned goods, and fertilizers	3,881	217,100
Grain and potatoes	2,451	83,975
General merchandise	400	12,000
Total	29,721	469,450
Total receipts and shipments	67,396	1,051,405

Vessels trading in Mispillion Creek, Delaware.

Class.	No.	Aggregate tonnage.	Draft.	Trips.
			Feet.	
Tugs	1	20	5	Daily.
Schooners	28	1,550	4½ to 7	5 to 30 trips per year.
Barges	3	500	7	3 trips each.

Vessels built at Milford, Del., during the year ending June 30, 1892.

Class.	No.	Registered total tonage.	Draft of largest vessel when leaving ship-yard.	Calculated maximum draft, when loaded, of largest vessel built.
Schooners	2	272	3½ and 4 feet.	7½

The above statistics were furnished by Mr. George F. Pierce, of Milford, Del.

H 6.

IMPROVEMENT OF BROADKILN RIVER, DELAWARE.

There were no operations during the fiscal year ending June 30, 1892, for want of funds. The original project for improvement was made in 1871, and is for a 6-foot low-water navigation from the mouth of the river to Milton, the head of navigation, and for a new entrance, protected by a jetty, at an estimated cost of $80,447. This project was modified in 1881 relative to the entrance and the estimate reduced to $51,450. The channel within the river has been completed in accordance with the project at an expense of $35,000, which was the total amount expended at the close of the fiscal year ending June 30, 1891.

The amount required for the completion of the existing project is for the improvements at the mouth of the river as designed twenty years ago. In view of the projected location, only a few miles below the Broadkiln, of the outlet for the inland waterway from Chincoteague Bay to Delaware Bay, a possibility has lately arisen that the Broadkiln can be connected with the waterway at much less cost and with greater advantage to both than if the existing project were carried out. It is recommended, therefore, for the present not to appropriate any money for a new entrance.

This work is in the collection district of Delaware. Wilmington is the nearest port of entry, at which the amount of revenue collected during the fiscal year ending June 30, 1892, is $10,533.75.

AMOUNTS APPROPRIATED.

By act approved—	
March 3, 1873	$10,000
June 14, 1880	5,000
March 2, 1881	5,000
By act passed August 2, 1882	5,000
By act of August 11, 1888	10,000

Money statement.

Amount (estimated) required for completion of existing project	$21,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts:		
Raw products	600	$3,000
Manufactured products	600	7,000
General merchandise	5,000	200,000
Total	6,200	210,000
Shipments:		
Raw products	30,100	61,000
Manufactured products	1,871	42,000
Agricultural products	570	11,000
Total	32,541	114,000
Total receipts and shipments	38,741	324,000

There were built during the past year three vessels, at a cost of $45,000. Tonnage belonging to river, 1,300 tons; transient, 1,000 tons; draft of vessels trading in the river, from 4 to 7 feet.

The above statistics were kindly furnished by Ex-Governor James Ponder, of Milton, Del.

H 7.

IMPROVEMENT OF INLAND WATERWAY FROM CHINCOTEAGUE BAY, VIRGINIA, TO DELAWARE BAY, AT OR NEAR LEWES, DELAWARE.

The object of this improvement is to connect, by a navigable channel, the many inland bays or lagoons which skirt the Atlantic coast in the counties of Accomac, Va., Worcester, Md., and Sussex, Del.; the termini to be on the south, Chincoteague Inlet and on the north, Delaware Bay at or near the Delaware Breakwater Harbor. The total length of the proposed waterway is about 73 miles.

The project is based upon a survey made in 1884 in accordance with the requirements of the river and harbor act of July 5, 1884. The reports on the survey printed in the report of the Chief of Engineers for 1885, pages 891–904, recommend a channel and open cut, between the points named, 70 feet wide at the bottom and 6 feet deep below the mean low water in the Delaware Breakwater Harbor, at an estimated cost of $350,000.

The project was adopted in 1886, an appropriation $18,750 being made by Congress on August 5, with special direction that it should be expended within that section of the proposed waterway situated between Chincoteague Bay and Indian River Bay. The Chief of Engineers subsequently approved a recommendation, made by the officer in charge, to apply the appropriation to connecting the waters of Assawoman Bay and Indian River Bay by excavating a cut, 8 feet wide at the bottom and 6 feet deep, referred to mean low water of the ocean. A new route was also recommended, in the place of the one originally surveyed between these bays, which was further inland, shorter in distance, and which required less excavation. By avoiding the sandy soil and a close proximity to the ocean, it was thought that the permanency of the cut would be increased. The new line, which is nearly 4 miles long, and runs straight from Jefferson Creek, a tributary of Assawoman Bay, to White Creek, a tributary of Indian River Bay, was approved in January, 1887.

Operations were delayed for over a year, awaiting the settlement of the question of the right of way, which was to be given free of cost to the United States. On July 2, 1888, the Attorney-General of the United States approved the title to the lands needed and vested in the General Government by an act of the Delaware legislature, passed at Dover April 4, 1887.

On August 11, 1888, Congress made an additional appropriation of $50,000 for continuing improvement and directed that this sum also be used between Chincoteague Bay and Indian River Bay. A new project was thereupon submitted and approved to apply this money, together with the balance of the former appropriation, to increasing the dimensions of the proposed cut between Assawoman Bay and Indian River Bay, the width and depth to be governed by the price at which the work could be contracted for.

Proposals for connecting the bays above named by a cut 4 miles long, 30 feet wide, and 6 feet below the average water level of Assawoman Bay, were opened November 2, 1888. The bids received were considered too high and were rejected. The work was immediately readvertised, the dimensions of the cut having been reduced to a width of 20 feet at the bottom and to a depth of 2 feet below the level of the bay. Proposals were opened on December 18, following. The lowest bid appeared to be reasonable in price. After an investigation, however, it was found that the guarantors to the proposal were irresponsible parties, and that the bidders themselves were pecuniarily unable to carry on the work, and their bid was therefore rejected. With the approval of the Chief of Engineers a contract was entered into on January 24, 1889, with the next lowest bidder, at his bid of 21.9 cents per cubic yard, measured in place.

Work under this contract was begun February 14, 1889, and was completed on June 18, 1891. In July, 1889, a supplementary agreement had been made with the contractor to increase the depth in the cut to 4 feet below the level of Assawoman Bay, the width on the bottom to remain as previously fixed, 20 feet, and no payments for the additional depth to be made until the 4-foot depth had been excavated from the corresponding depth in one bay to that in the other. The price for removing material in the cut below the originally specified depth was to be the same as that in the original contract, viz, 21.9 cents; the dredging in the bays, however, was to be paid for at the rate of 12 cents per cubic yard. The total number of cubic yards of material removed under the contract was 248,815.

During the fiscal year ending June 30, 1891, three temporary wooden bridges were built at public road crossings over the excavated canal above referred to. At the beginning of the past fiscal year authority had been received from the Chief of Engineers to provide these bridges with draws, which was subsequently done under an informal contract with C. McLean, of New York, at a cost of $200 each. Small shoals had also formed in the cut by reason of the caving in of the banks at the outlet of several surface drains and a dredge was hired by the day to remove these and a bar which had formed at the crossing of the canal at Jefferson Creek. The total amount paid for this work and for digging two small trenches as surface drains at certain points along the canal was $630. All the above work was finished by the middle of September, 1891. About the same time a system of noting the traffic over and through the three bridges was instituted by the employment of a recorder at each bridge, who is making weekly reports. The results are given under the heading of commercial statistics at the end of this report. The water and wind observations, as obtained by a self-registering apparatus at the Jefferson Creek Bridge of the canal, were continued during the past fiscal year.

At the beginning of the fiscal year ending June 30, 1892, the appropriation of $50,000 made by the river and harbor act of September 19, 1890, was still unavailable. The reasons have been fully set forth in the report on the survey of a canal between Rehoboth Bay and Delaware Bay, a part of the proposed inland water way between Chincoteague Bay, Va., and Delaware Bay, which is printed in the Report of the Chief of Engineers for 1891, pages 1171 to 1181. The matter has since received a different status, as will appear from the following correspondence printed as Ex. Doc. No. 85, United States Senate, Fifty-second Congress, first session.

War Department,
Washington, April 21, 1892.

Sir: I have the honor to transmit a letter from the Chief of Engineers, dated the 21st instant, inclosing copies of the correspondence between the Delaware Congressional delegation and the War Department relative to the location of the proposed water way between Delaware Bay and Rehoboth Bay on line of the inland water way between Chincoteague Bay and Delaware Bay, together with copies of reports of December 18, 1891, and February 4, 1892, with inclosures, from W. F. Smith, United States agent, major of Engineers, retired; which correspondence is furnished in answer to a resolution of the Senate dated April 20, 1892, calling for the same.

Very respectfully,

S. B. Elkins,
Secretary of War.

The President of the United States Senate.

Office of the Chief of Engineers,
United States Army,
Washington, D. C., April 21, 1892.

Sir: I have the honor to acknowledge receipt from the War Department of Senate resolution of the 20th instant, and in answer to its reference to this office for report to submit the accompanying copies of the correspondence between the Delaware Congressional delegation and the War Department, relative to the location of the proposed water way between Delaware Bay and Rehoboth Bay, on line of the inland water way between Chincoteague Bay and Delaware Bay, together with copies of reports of December 18, 1891, and February 4, 1892, with inclosures, from William F. Smith, United States agent, major of Engineers, U. S. Army, retired, on the same subject.

The resolution of the Senate is returned herewith.

Very respectfully, your obedient servant,

Thos. Lincoln Casey,
Brig. Gen., Chief of Engineers.

Hon. S. B. Elkins,
Secretary of War.

LETTER FROM THE CONGRESSIONAL DELEGATION OF THE STATE OF DELAWARE.

Wilmington, Del., *December 1, 1891.*

Dear Sir: It appears by a report of the Chief of Engineers of the Army and of the Division Engineer, Col. Craighill, that the cost of the inland water way between Delaware Bay and Rehoboth Bay will amount to $718,226, and that the ultimate cost may be found to be near $1,000,000, rather than $231,500, the estimate submitted, and, in view of these statements, the Chief Engineer recommends that the whole matter be remanded to Congress, and that the $50,000 appropriated by act of September 19, 1890, be not expended until Congress has taken further action in the matter.

Since learning of the above-reported recommendation, we, with others interested, have taken into consideration whether a canal of smaller dimensions and much less cost would not suffice for the present needs, and have concluded that it would.

The original project upon which these appropriations were made was for a water way 70 feet wide at the bottom and 6 feet in depth at mean low water. The project under the appropriations has been carried through for a cut between Indian River and Assawoman bays of 20 feet in width at bottom and 4 feet in depth at mean low water. This has initiated a business by water of value to the States of Delaware, Maryland, and Virginia. We desire to say that, for all commercial purposes for years to come, it would seem that a canal of much less cross section would be all that is needed, and that, if need be, in the future such canal may be widened to suit such increase in commerce. The suggestion has also been made from citizens of the locality that another route be laid down for the canal which would cost very much less money, and, at the same time, avoid the objections raised by Mr. Stierle, the assistant engineer, to the route as located by Mr. Charles Bird.

We therefore request the Secretary to order the reëxamination of the question to see whether by a decreased area of cross section, and possibly with a change of route, a project may not be presented which shall satisfy the needs of commerce and keep the expenditure at least within the money already appropriated.

Very truly, yours,

GEO. GRAY,
ANTHONY HIGGINS,
J. W. CAUSEY.

WAR DEPARTMENT, *December 11, 1891.*

Respectfully referred to the Chief of Engineers for report.

By order of the acting Secretary of War:

JOHN TWEEDALE,
Chief Clerk.

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
December, 14, 1891.

Respectfully referred to W. F. Smith, United States agent, major of engineers, U. S. Army, retired, for report.

To be returned.

By command of Brig. Gen. Casey:

H. M. ADAMS,
Major, Corps of Engineers.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[Fourth indorsement.]

U. S. ENGINEER OFFICE,
Wilmington, Del., December 18, 1891.

Respectfully returned to the Chief of Engineers, U. S. A., with accompanying report of this date.

WM. F. SMITH,
United States Agent.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[Seventh indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., December 24, 1891.

Respectfully returned to the Chief of Engineers.

I have recently made an inspection of much of this route. I believe a canal of the dimensions mentioned by the local engineer in his report of December 18, 1891, will suffice for present needs and for a number of years, if provided with turn-outs as proposed. The work can be done for the sum of money given in his estimate in the same report, provided the appropriations be liberal and the work not drawn out over many years instead of being completed in two, as it might readily be if in the hands of an efficient contractor.

The additional survey proposed by the local engineer is recommended.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

[Eighth indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
December 28, 1891.

Respectfully returned to the Secretary of War.

Hons. George Gray, Anthony Higgins, and John W. Causey request reëxamination of the question, to determine whether, by a decrease of cross section and possibly a change of route, a project for the water way between Chincoteague Bay and Delaware Bay may not be presented which shall satisfy the needs of commerce and keep the expenditure within the money already appropriated.

Inviting attention to the accompanying report of W. F. Smith, United States agent, Major of Engineers, U. S. A., retired, the officer in charge of the work, and report of Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division, I have to recommend that Maj. Smith be authorized to run the proposed new line of levels between the upper part of the Stockley Creek and Bird route, at an estimated cost of $250, to be paid from appropriation for examinations, surveys, and contingencies of rivers and harbors.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Ninth indorsement.]

WAR DEPARTMENT, *December 29, 1891.*

Approved as recommended by the Chief of Engineers.

By order of the Acting Secretary of War:

JOHN TWEEDALE,
Chief Clerk.

[Tenth indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
February 10, 1892.

Respectfully returned to the Secretary of War.

The examination within requested by the Senators and Representatives from Delaware for a new route for canal between Rehoboth Bay and Delaware Bay has been completed, and copies of Major Smith's report, dated February 4, 1892, and accompanying paper submitting the results of the examination, are inclosed, with recommendation that they be furnished Senator Gray.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

LETTER OF THE ACTING SECRETARY OF WAR.

WAR DEPARTMENT,
Washington, December 11, 1891.

SIR: I have the honor to acknowledge the receipt of the joint letter, dated the 1st instant, of yourself, Hon. Anthony Higgins, and Hon. John W. Causey, relative to the construction of the inland water way between Delaware Bay and Rehoboth Bay upon a smaller scale than originally proposed, and in reply beg to advise you that the matter has been referred to the Chief of Engineers for his views thereon.

Very respectfully,

L. A. GRANT,
Acting Secretary of War.

Hon. GEORGE GRAY,
United States Senate.

LETTER OF THE ACTING SECRETARY OF WAR.

WAR DEPARTMENT,
Washington, December 11, 1891.

SIR: I have the honor to acknowledge the receipt of the joint letter, dated the 1st instant, of yourself, Hon. George Gray, and Hon. John W. Causey, relative to the construction of the inland water way between Delaware Bay and Rehoboth Bay upon a smaller scale than originally proposed, and in reply beg to advise you that the matter has been referred to the Chief of Engineers for his views thereon.

Very respectfully,

L. A. GRANT,
Acting Secretary of War.

Hon ANTHONY HIGGINS,
United States Senate.

LETTER OF THE ACTING SECRETARY OF WAR.

WAR DEPARTMENT,
Washington, December 11, 1891.

SIR: I have the honor to acknowledge the receipt of the joint letter, dated the 1st instant, of yourself, Hon. George Gray, and Hon. Anthony Higgins, relative to the construction of the inland water way between Delaware Bay and Rehoboth Bay upon a smaller scale than originally proposed, and in reply beg to advise you that the matter has been referred to the Chief of Engineers for his views thereon.

Very respectfully,

L. A. GRANT,
Acting Secretary of War.

Hon. JOHN W. CAUSEY,
House of Representatives.

REPORT OF WM. F. SMITH, UNITED STATES AGENT, MAJOR OF ENGINEERS, U. S. ARMY, RETIRED.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., December 18, 1891.

GENERAL: In compliance with the instructions contained in the second indorsement on the accompanying letter, dated December 1, 1891, relating to a reduction in the dimensions of the proposed canal between Rehoboth Bay and Delaware Bay, I have the honor to report that for a certain kind of commerce a canal of 6 feet in depth at low water, with a width of 20 feet at the bottom and necessary turn-outs for the passing of vessels, would be ample, and probably such a canal would answer all necessary purposes, except during war time, for some years to come. When needed, the canal could then be widened to suit exigencies.

I have made an estimate for such a canal on the line recommended in my report of April 7, 1891, on the survey for a canal from Rehoboth Bay to Delaware Bay, called the "Stockley Creek route," with turn-outs at every mile of distance of 70 feet in width at bottom and 6 feet in depth at low water and 150 feet in length.

The amount of material to be excavated for such a cross section is as follows:

For fast land, 3 feet and over above high water, 907,148 cubic yards, at 20 cents	$181,429.60
In marshes and glades, 744,182 cubic yards, at 15 cents	111,627.30
	293,056.90
Add—	
For grubbing 50 acres, at $50	2,500.00
For two railroad bridges of iron, at $5,500	11,000.00
For two county road bridges, at $1,000	2,000.00
	308,556.90
Ten per cent for contingencies of engineering, etc	30,855.69
Total	339,412.59

Taking into consideration the reduction in the cross section of the canal, it is possible that a new line of levels run over a small portion of the line between the upper part of the Stockley Creek and Bird route might develop a cheaper line for a canal of the diminished dimensions. To determine that, a survey should be made, for which I would estimate the cost at $250.

Very respectfully, your obedient servant,

WM. F. SMITH,
United States Agent.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

REPORT OF WILLIAM F. SMITH, UNITED STATES AGENT, MAJOR OF ENGINEERS, U. S. ARMY, RETIRED.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., February 4, 1892.

GENERAL: Referring to my report of December 18, 1891, in which the suggestion is made that a new line of levels run over a portion of the line between the upper part of the Stockley Creek and Bird route, a part of the proposed water way from Chincoteague Bay, Virginia, to Delaware Bay might develop a cheaper line for a canal of diminished dimensions, I have the honor to submit the following report upon a survey of the section referred to, made in January, 1892, in accordance with instructions contained in Department letter dated December 30, 1891.

An estimate for a new route, which is shown on the tracing forwarded by mail today, in a separate package, providing for a canal 20 feet wide at bottom and 6 feet below mean low water, is herewith submitted.

The new line, on leaving Lewes Creek, follows close along the fast land bordering on the marsh land of the valley, so as to have part excavation and part embankment for the water way, and giving an outside embankment of sufficient cross section to resist the currents and waves on the marsh lands in case of excessive tides accompanied with gales.

From the information gathered from the inhabitants of the locality, it is believed that the selected line will be measurably safe from such encroachments.

This new route is 2,950 feet longer than the first recommended.

The estimates for a canal 20 feet wide at bottom and 6 feet deep are as follows: Along the Stockley Creek route, $339,412; along the Lewes Creek route, the last one surveyed, $241,224. Only two bridges, suitable for use by railroad and wagon road, are included in the estimate for the latter route, at a cost of $7,500 each. This latter item presupposes a willingness on the part of the State of Delaware to have the wagon roads of the locality changed to suit the proposed bridges. I am assured that that will be done. Such a change would be of great value both in the cost of bridges and in the number of them, which should be made as small as is consistent with adequate facilities to the inhabitants of the locality. A copy of the report of Mr. A. Stierle, assistant engineer, upon the survey, is herewith inclosed.

Very respectfully, your obedient servant,

WM. F. SMITH,
United States Agent.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[Third indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., February 9, 1892.

Respectfully returned to the Chief of Engineers.

When the Stockley Creek route was approved, it was with the expectation the canal would be of the larger size. The proposition of the Delaware delegation in Congress to diminish the dimensions of the canal reopened the question of location in part. The new route now proposed by the local engineer will answer for the smaller canal, and is very much cheaper than the portion of the previously adopted route for which its substitution is suggested.

To be enabled to dispense with several bridges is a very great advantage. If there were a question of rapid transit, the greater length of the new route would be a serious objection to it, but this is not thought to be a matter of much importance in this case.

The change of route to the extent suggested by the local engineer, and as shown on the tracing which accompanied his report, is recommended.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF MR. A. STIERLE, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., February 4, 1892.

SIR: In compliance with your orders, a survey was recently made of a portion of the country near Rehoboth Bay, Delaware, "between the upper part of the Stockley Creek and Bird route, with the view to develop a cheaper line for a canal of diminished dimensions," for the inland water way between Rehoboth and Delaware bays.

This small portion was not included when the general surveys were made, and citizens of the locality had suggested that a line through it would probably cost no more than one following the low lands along Lewes Creek, and would be located at a greater distance from the shore of the ocean. The section referred to is immediately south of Hollands Glade, and embraces the numerous water courses leading into Gordons Pond from the westward. A traverse line and a line of levels were run over the grounds indicated, and the result was plotted on the general map made last year.

The data obtained facilitate the projection of a new route for a canal with reduced dimensions. The route is named the Lewes Creek route, and is shown in green on the accompanying tracing. The Stockley Creek route, for which an estimate for a canal of diminished dimensions was submitted to the Department on December 18, 1891, is shown on the same sheet in red. The estimate was $339,412 for a cut 20 feet wide on the bottom and 6 feet deep below mean low-water level. The estimate for a cut of the same cross section along the route herewith submitted—the Lewes Creek route—is $241,224. The latter route is about one-half of a mile longer, and runs throughout its whole course adjacent to and nearly parallel with the preliminary line of 1885, with this difference, that the greater portion of it is made to abut against or to follow the base of the high land on the western edge of the great marsh through which Lewes Creek flows. The prices adopted for the cost of excavating in both the estimates above referred to, viz, 20 cents per cubic yard for material above and 15 cents for that below high-water level, are believed to be near the present market value of that kind of work, with a slight inclination toward the margin of safety. The usual percentage (10) for contingencies was also added to the estimates.

The preliminary estimate for the "cheapest" route, the Lewes Creek route, is as follows:

Excavation (1,177,023 cubic yards):	
Above high-water level, 550,829 cubic yards, at 20 cents	$110,165.80
Below high-water level, 626,194 cubic yards, at 15 cents	93,929.10
Grubbing 4 acres, at $50 per acre	200.00
Two combination drawbridges for railroad and public traffic, at $7,500 each	15,000.00
	219,294.90
Add 10 per cent for contingencies	21,929.10
Total	241,224.00

The results of the reëxamination ordered by the Secretary of War, upon the request of the Congressional delegation from Delaware, have failed to bring to light a new route for a canal "which would cost very much less money" than those already considered; and the reduction of the estimates now submitted is altogether due to the reduction in the cross-sectional area of the canal, which, with a less width than originally proposed, is held to be sufficient for the present needs of commerce. The advantages of the Stockley Creek route and the objections to any other route, like the Lewes Creek route, following mainly the lowlands in close proximity to the ocean, have been fully described in the report of April 7, 1891.

Very respectfully, your obedient servant,

A. STIERLE,
Assistant Engineer.

Gen. WM. F. SMITH,
United States Agent.

LETTER OF THE ASSISTANT SECRETARY OF WAR.

WAR DEPARTMENT,
Washington, February 12, 1892.

SIR: Referring to the joint request of yourself, Senator Higgins, and Representative Causey, dated December 1, 1891, that this Department order a reëxamination of the route and plans for an inland water way between Delaware and Rehoboth bays with a view of ascertaining whether a different route and a decreased area of cross section of a canal can not be selected which shall satisfy the needs of commerce, and keep the expenditure within the money appropriated by the act of September 19, 1890, I have the honor to advise you that, under instructions from the Chief of Engineers, the officer in charge of the improvement has made a new survey of a portion of the line between the upper part of Stockley Creek and Bird route, which is a part of the proposed water way; and I now have the honor to transmit herewith, for the information of yourself, Senator Higgins, and Representative Causey, a copy of a report of Maj. W. F. Smith, United States Engineers, retired, dated the 4th instant, together with a copy of the report of his assistant engineer, of the same date, on the subject.

The tracing referred to in the report of Maj. Smith is retained in the office of the Chief of Engineers.

Very respectfully,

L. A. GRANT,
Assistant Secretary of War.

Hon. GEORGE GRAY,
United States Senate.

LETTER FROM THE CONGRESSIONAL DELEGATION OF THE STATE OF DELAWARE.

UNITED STATES SENATE,
Washington, D. C., February 26, 1892.

SIR: Your letter of the 12th instant is received, transmitting the report of Maj. W. F. Smith recommending a new route for a portion (between Delaware and Rehoboth bays) of the inland water way, with the favorable indorsement thereon of Col. W. P. Craighill, Division Engineer, and in response thereto we desire to express our approval of the proposed change of route and cross section, and request that immediate steps be taken to obtain the title and begin the work under the appropriation made by the act of 1890.

Very respectfully,

GEO. GRAY.
ANTHONY HIGGINS.
J. W. CAUSEY.

The SECRETARY OF WAR.

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
March 1, 1892.

Respectfully returned to the Secretary of War.

The act of July 5, 1884, provided for survey of line for inland water way from Chincoteague Bay to Delaware Bay. Under this act a survey was made and estimates submitted for continuous inland navigation from Chincoteague Bay to Delaware Bay. Proposed width of channel at bottom, 70 feet; depth at mean low water, 6 feet; estimated cost, $350,000.

The section between Rehoboth and Delaware bays was estimated to cost as follows:

New channel in Delaware Bay	$23,280
New mouth to Rehoboth Bay	219,580
Dredging Rehoboth Bay at Thompsons Island	500
	243,360

Upon survey following act of September 19, 1890, for location of route between Rehoboth and Delaware bays, an estimate for the line selected (Stockley Creek route) was submitted by W. F. Smith, United States agent, Major of Engineers, U. S. Army, retired, amounting to $574,581. This estimate was increased by Col. Wm. P. Craighill, Corps of Engineers, 25 per cent, $143,645; total, $718,226.

At the request of the Delaware Congressional delegation a new line of levels was run between Rehoboth and Delaware bays, with view to a cheaper line for a canal of smaller dimensions.

Report on this survey, with estimates for canal 20 feet wide at bottom and 6 feet deep, was submitted February 4, 1892. The estimates submitted are as follows:

Stockley Creek route	$339,412
Lewes Creek route (the one last surveyed)	241,224

Appropriations have been made for the water way as follows:

August 5, 1886	$18,750
August 11, 1888	50,000
September 19, 1890	50,000

It is recommended that the new route be adopted and that Maj. Smith be directed to secure, if possible, the right of way free of cost to the United States, as contemplated by act of September 19, 1890.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Third indorsement.]

WAR DEPARTMENT, *March 2, 1892.*

Approved as recommended by the Chief of Engineers.
By order of the Secretary of War.

JOHN TWEEDALE,
Chief Clerk.

After the approval of the line the necessary fieldwork for the location of the boundary lines was begun. This was somewhat difficult work, as the marshes and branches are generally covered with water during the spring of the year, but it was finally accomplished about the middle of April last and the map and description of the land were subsequently prepared. The strip of land appropriated for the canal is 300 feet wide, and comprises a total area of 271.09 acres from Delaware Bay to Rehoboth Bay. The commissioners appointed by the legislature of the State of Delaware have recently proceeded over the line and condemned the land. Their final awards for damages were tendered to the parties in interest on June 25, 1892.

It is proposed to begin active operations as soon as the title to the land is acquired by the United States.

AMOUNTS APPROPRIATED.

By act—	
Approved August 5, 1886	$18,750
Of August 11, 1888	50,000
Approved September 19, 1890	50,000

Money statement.

July 1, 1891, balance unexpended	$60,164.72
June 30, 1892, amount expended during fiscal year	9,347.59
July 1, 1892, balance unexpended	50,817.13
Amount appropriated by act approved July 13, 1892	25,000.00
Amount available for fiscal year ending June 30, 1893	75,817.13
Amount (estimated) required for completion of existing project	206,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

Receipts and shipments from November 16, 1891, to June 30, 1892.

Class.	Tons.	Value.
Receipts:		
Coal	18	$135
Bricks, flour, and furniture	64	3,575
Corn, hay, clams, and oysters	33	882
General merchandise	20	2,000
Total	135	6,592
Shipments:		
Logs and ship timber	135	3,654
Iron supplies and sawed lumber	1,216	6,320
Soft crabs and fish	3	321
General merchandise	4	500
Total	1,358	10,795
Total receipts and shipments	1,493	17,387

Vessels using the inland waterway from November 16, 1891, to June 30, 1892.

Class.	No.	Aggregate tonnage.	Draft.	Trips.
			Feet.	
Steam launches	1	5	2½	8
Schooners	3	30	2¼ to 3½	2 to 6
Sloops	3	18	1 3	2 4
Bateaux	3	11	2	2 6

H 8.

IMPROVEMENT OF SUSQUEHANNA RIVER ABOVE AND BELOW HAVRE DE GRACE, MARYLAND.

There were no operations during the fiscal year ending June 30, 1892, and the appropriation of $4,000 made by the river and harbor act of September 19, 1890, is still unexpended. A report upon a survey of this river above Havre de Grace, provided for in the same act, was submitted December 26, 1891, with estimates for a new project.

The original project for improvement above and below Havre de Grace includes the making of a 15-foot low-water channel below the town and the removal of a shoal on the west side of the channel opposite Watson Island to a depth of 8 feet below mean low water. The channel below the town was dredged to the depth of 12 feet in 1885. The recent survey showed that it had partially shoaled again. The removal of the eastern bank of the shoal opposite Watson Island has been in progress since 1883, and is done to prevent, in a measure, the formation of ice gorges at or near the town of Port Deposit, situated 2½ miles above the island. About $32,000 have been expended in dredging this shoal, resulting in some temporary relief, but the recent survey shows that the area dredged has resumed nearly its original state since work has been discontinued.

Susquehanna River is in the collection district of Baltimore, which is the nearest port of entry. The amount of revenue collected there during the fiscal year ending June 30, 1892, is $3,178,558.44.

AMOUNTS APPROPRIATED.

By act approved—	
August 30, 1852	$10,000
June 23, 1866	26,400
July 11, 1870	12,000
June 14, 1880	28,000
March 3, 1881	15,000
By act passed August 2, 1882	25,000
By act approved—	
July 5, 1884	20,000
August 5, 1886	6,000
By act of August 11, 1888	10,000
By act approved September 19, 1890	4,000

Money statement.

July 1, 1891, balance unexpended	$4,202.35
June 30, 1802, amount expended during the fiscal year	107.66
July 1, 1892, balance unexpended	4,094.69
Amount appropriated by act approved July 13, 1892	4,000.00
Amount available for fiscal year ending June 30, 1893	8,094.69
Amount (estimated) required for annual dredging	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Statistics of Susquehanna River, above and below Havre de Grace, Md., for the year ending December 31, 1891.

Class.	Tons.	Value.
Coal	74, 365	$408, 475
Lumber, shingles, and timber	18, 000	113, 450
Stone, sand, and ground flint	11, 000	51, 750
Fertilizers	4, 900	65, 000
Hay and grain	2, 724	52, 305
Canned goods, fish, empty barrels, and granite	5, 342	204, 620
General merchandise	270	13, 200
Total	116, 601	908, 800

The above statistics were furnished by Messrs. McClenahan & Bro., Eureka Fertilizing Company, and Spencer & McGonigle, of Port Deposit, Perryville, and Lapidum, Md., respectively.

H 9.

IMPROVEMENT OF NORTHEAST RIVER, MARYLAND.

There were no operations during the fiscal year ending June 30, 1892.

The appropriation of $2,500 made by act approved September 19, 1890, was expended during the fiscal year ending June 30, 1891, in dredging a channel 40 feet wide, 6 feet deep at low water and 5,700 feet long, beginning at a point 3,200 feet below the bar and extending to deep water inside the river at the mouth of Stony Run.

The approved project, adopted in 1890, is for a channel 6 feet deep at mean low water, 75 feet wide at the bar and 60 feet wide in the river proper up to Davis Wharf. The estimated cost of the improvement is $5,140. This channel had previously been improved by the General Government during the years 1873 and 1881 and the sum of $15,500 had been expended.

The channel recently dredged is reported to be in fair condition; the increase in commerce is, however, not very marked.

The amount asked for is the balance required to complete the project, and will be expended, if appropriated, for that purpose.

This work is in the collection district of Baltimore, which is the nearest port of entry. The amount of revenue collected there during the fiscal year ending June 30, 1892, is $3,178,558.44.

AMOUNTS APPROPRIATED.

By act approved—

June 10, 1872	$10, 000
June 14, 1880	5, 000
September 19, 1890	2, 500

Money statement.

July 1, 1891, balance unexpended	$2, 393. 85
June 30, 1892, amount expended during fiscal year	2, 332. 22
July 1, 1892, balance unexpended	61. 63
Amount appropriated by act approved July 13, 1892	2, 640. 00
Amount available for fiscal year ending June 30, 1893	2, 701. 63

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts—		
Coal and cord wood	1,760	$4,200
Fertilizers, lumber, and shingles	11,248	143,400
Total	13,008	147,700
Shipments—		
Cord wood	1,000	3,000
Canned goods and sawed timber	1,200	44,800
Grain, hay, and potatoes	6,260	77,000
Total	8,460	124,800
Total receipts and shipments	21,468	272,500

The above statistics were furnished by the McCullough Iron Company, of North East, Md.

H 10.

IMPROVEMENT OF ELK RIVER, MARYLAND.

At the beginning of the past fiscal year a contract had been made for the expenditure, in dredging, of the appropriation of $10,000 made by the river and harbor act of September 19, 1890. Operations were begun on August 11 and completed on November 4, 1891, the total amount of material removed under the contract being 56,069 cubic yards, consisting principally of sand and mud occasionally intermixed with fire clay and gravel. About one-half of the material was carried away in scows and dumped in a wide cove of the river, about 5 miles below Elkton; the remainder was deposited upon the adjoining banks along the cut. The channel dredged was made 100 feet wide and 8 feet deep at mean low water for a continuous length of 3,800 feet, from the iron county bridge above Scotts Wharf, at the head of navigation, to Morgans Gut. A small shoal, having less than 8 feet of water over it at low tide and situated about 1,600 feet below the junction of Little Elk River, was also removed to the approved width and depth, as it prevented, in a measure, the immediate use of the improvements in the upper section of the river.

The present project for improvement is based upon a survey of the river made in 1889, and provides for an 8-foot channel from the iron county bridge above Scotts Wharf to deep water below Cedar Point. The width of the channel is to be 100 feet except at the wharves, where it may be increased to the existing width between the present wharf lines. This project was adopted in 1890 and during the past fiscal year the first appropriation made for it was expended. The dredged channel was reported to be in fair condition at the end of the fiscal year. Dredging will be continued under the approved project if the amount asked for is appropriated.

Elk River is in the collection district of Baltimore, which is the nearest port of entry. The amount of revenue collected there during the fiscal year ending June 30, 1892, is $3,178,558.44.

AMOUNTS APPROPRIATED.

By act approved—	
June 23, 1874	$5,000
March 3, 1875	5,000
June 14, 1880	10,000
March 3, 1881	5,000
By act passed August 2, 1882	6,500
By act approved September 19, 1890	10,000

Money statement.

July 1, 1891, balance unexpended	$9,942.18
June 30, 1892, amount expended during fiscal year	8,846.41
July 1, 1892, balance unexpended	1,095.77
Amount appropriated by act approved July 13, 1892	5,000.00
Amount available for fiscal year ending June 30, 1893	6,095.77
Amount (estimated) required for completion of existing project	9,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	9,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts:		
Coal, wood, and phosphate rock	10,259	$67,708
Fertilizers	850	17,000
Total	11,109	84,708
Shipments:		
Canned goods	1,334	31,200
Grain and hay	4,665	136,400
Total	5,999	167,600
Total receipts and shipments	17,108	251,308

Vessels trading in Elk River, Maryland.

Class.	No.	Aggregate tonnage.	Draft.	Trips.
			Feet.	
Steamer	1		5	Semiweekly.
Tugboat	1	12	6½	Whenever required.
Schooners	81	3,000	3 to 7½	During season.
Sloops	2	60	6	Weekly and biweekly.

The above statistics were furnished by the Scott Fertilizer Company, Elkton, Md.

H II.

IMPROVEMENT OF FAIRLEE CREEK, MARYLAND.

There were no operations during the fiscal year ending June 30, 1892.

The appropriation of $5,000 made September 19, 1890, was expended during the fiscal year ending June 30, 1891, in widening the channel previously made at the mouth of the creek to 100 feet, and in dredging a channel 50 feet wide and 4,738 feet long inside the creek, the depth made in both cases being 7 feet below mean low water.

The project adopted in 1888 embraces the dredging of a channel 100 feet wide and 7 feet deep at mean low water across the bar at the mouth and up the creek for a distance of about 2¾ miles; also the dredging of a turning basin at the upper end of the proposed channel, if a certain wharf should be built there before the channel is completed. The total estimated cost of the improvement is $15,558. No appreciable increase in the commerce of the creek, which has always been very limited, has been noted since improvements were begun.

The amount asked for, if appropriated, will be expended in completing the channel inside the creek.

Fairlee Creek is in the collection district of Baltimore, which is the nearest port of entry. The amount of revenue collected there during the fiscal year ending June 30, 1892, is $3,178,558.44.

AMOUNTS APPROPRIATED.

By act—	
Of August 11, 1888	$5,000
Approved September 19, 1890	5,000

Money statement.

July 1, 1891, balance unexpended	$115.35
July 30, 1892, amount expended during fiscal year	92.88
July 1, 1892, balance unexpended	22.47
Amount (estimated) required for completion of existing project	5,558.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	5,558.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts:		
Bone, coal, and phosphate rock	500	$7,600
Bricks, fertilizers, and lumber	798	12,400
General merchandise	200	5,000
Total	1,498	25,000
Shipments:		
Logs, railroad ties, etc	1,522	5,180
Eggs, grain, hay, and potatoes	8,459	212,125
Total	9,981	217,305
Total receipts and shipments	11,479	242,305

The above statistics were furnished by Judge W. S. Walker, of Chestertown, Md.

H 12.

IMPROVEMENT OF CHESTER RIVER, MARYLAND, FROM CRUMPTON TO JONES LANDING.

At the beginning of the past fiscal year a contract had been made for dredging in accordance with the approved project, under the appropriation made September 19, 1890. The work was begun on October

28, 1891, and the contract was completed on February 8, 1892. The total amount of material removed was 20,061 cubic yards, principally sand and mud. The application of the money resulted in improving a section of the river about 4 miles long, from Crumpton, at the lower end, up to Kirby Landing, the dredging being carried on only at points where the existing channel was too shoal or too narrow. The required depth and width of the channel is 6 and 60 feet, respectively. At several sharp turns this width was increased on an average 20 feet, to facilitate navigation by large boats. The material removed was deposited upon the shore along the river.

The adopted project for improvement is based upon a survey made in 1889, and is for a 6-foot low-water channel 60 feet wide, from the drawbridge at Crumpton to a point about 1 mile below Millington, supposed to be Jones Landing, a distance of 6¼ miles, at an estimated cost of $12,750. The work done during the past fiscal year was the first under this project.

The amount asked for, if appropriated, will be expended in completing the approved project.

This work is in the collection district of Baltimore, which is the nearest port of entry. The amount of revenue collected there during the fiscal year ending June 30, 1892, is $3,178,558.44.

AMOUNT APPROPRIATED.

By act approved September 19, 1890	$5,000

Money statement.

July 1, 1891, balance unexpended	$4,992.35
June 30, 1892, amount expended during fiscal year	3,088.58
July 1, 1892, balance unexpended	1,903.77
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	4,903.77
Amount (estimated) required for completion of existing project	4,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	4,750.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts:		
Fertilizers	452	$11,300
General merchandise	533	21,320
Total	985	32,620
Shipments:		
Garden truck	2,932	32.590
Grain	1,516	39.886
General merchandise	200	8,000
Total	4,648	80,476
Total receipts and shipments	5,633	113,096

Vessels trading in Chester River, Maryland.

Class.	No.	Aggregate tonnage.	Draft.	Trips.
			Feet.	
Steamers	1	368	7	Triweekly from July.

The above statistics were furnished by the Chester River Steamboat Company.

H 13.

IMPROVEMENT OF CHOPTANK RIVER, MARYLAND.

There were no operations during the fiscal year ending June 30, 1892. A contract for dredging has been made with Chester T. Caler, of Norfolk, Va., the work to begin on or before July 10, 1892. The available funds will be expended in widening and deepening to the full proposed width and depth the portions of the channel heretofore improved, and it is expected that the contract will be completed before the end of the present calendar year.

The object of this improvement, which has been carried on since 1881, is to make an 8-foot low-water navigation between Denton and Greensboro, Md., a distance of about 8 miles, the width of the channel to be 75 feet. The estimated cost of the improvement is $79,000.

At the close of the fiscal year ending June 30, 1891, $37,513.63 had been expended, and about 1¾ miles of the river remained that had only a depth of from 5 to 7 feet at low water. The width of the channel has in no case as yet reached 75 feet where dredging has been done.

It is proposed to expend the amount asked for, if appropriated, in dredging the channel to the full width and depth, in accordance with the original project.

This work is in the collection district of Baltimore, which is the nearest port of entry. The amount of revenue collected there during the fiscal year ending June 30, 1892, is $3,178,558.44.

AMOUNTS APPROPRIATED.

By act approved—	
June 14, 1880	$5,000
March 3, 1881	5,000
By act passed August 2, 1882	5,000
By act approved—	
July 5, 1884	5,000
August 5, 1886	10,000
By act of August 11, 1888	7,500
By act approved September 19, 1890	7,500

Money statement.

July 1, 1891, balance unexpended	$7,486.37
June 30, 1892, amount expended during fiscal year	281.65
July 1, 1892, balance unexpended	7,204.72
July 1, 1892, amount covered by uncompleted contracts	6,500.00
July 1, 1892, balance available	704.72
Amount appropriated by act approved July 13, 1892	3,000.00
Amount available for fiscal year ending June 30, 1893	3,704.72
Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts—		
Raw products	4,274	$12,100
Manufactured products	3,325	82,437
Agricultural products	276	13,685
General merchandise	1,210	96,400
Total	9,085	204,622
Shipments—		
Raw products	4,000	86,300
Manufactured products	2,795	197,980
Agricultural products	3,831	141,715
General merchandise	975	46,000
Total	11,601	471,995
Total receipts and shipments	20,686	676,617

Vessels trading to Denton and Greensboro, Md.

Class.	No.	Aggregate tonnage.	Draft.	Trips.
			Feet.	
Steamers	3	1,297	6	Triweekly.
Schooners	1	101	6	Irregular.

The above statistics were furnished by Mr. D. S. Brockway, of Greensboro, Md., and the Maryland Steamboat Company of Baltimore.

H 14.

IMPROVEMENT OF HARBOR AT CAMBRIDGE, MARYLAND.

Nothing was done during the fiscal year ending June 30, 1892. The appropriation of $5,000 made September 19, 1890, is still unexpended, pending the construction of a new draw in the bridge across the harbor. The present draw being deemed too small for the passage of large vessels, an increase in width to 60 feet had been proposed, to which the commissioners of the county in charge of the bridge at the time agreed, without, however, taking any active steps towards making the proposed change. An application recently made by them for a reduction in the proposed width of the draw from 60 to 40 feet was submitted to the Department on June 15, 1892. The existing draw is 29 feet wide

The approved project is based upon a survey made in 1887. It provides for a channel 150 feet wide and 12 feet deep at mean low water from that depth in the Choptank River to the railroad wharf; for dredging a certain irregular area in the harbor to a depth of 10 feet below mean low water, and for a channel 150 feet wide and 8 feet deep at the same stage of the tide, from the drawbridge to the upper end of the harbor.

The harbor has been under improvement by the General Government since 1871. Previous to that year the citizens of Cambridge had expended $7,500 in its improvement. A project was submitted in 1871 by Col. William P. Craighill, Corps of Engineers, which was approved, providing for a channel 150 feet wide across the bar at the entrance and for dredging the same, together with the interior harbor to a depth of 8 feet at mean low tide. This project was completed in 1879. As the channel at the entrance needed enlargement soon thereafter, an appropriation of $2,500 made the same year was expended in 1884 in increasing the width as far as the funds would permit. The amount expended under the first project was $32,500; up to the close of the fiscal year ending June 30, 1891, the sum of $4,918.72 had been expended under the existing project, making a total of $37,418.72.

The general result of the improvements is such that the larger class of schooners engaged in carrying ice and ship timber, which heretofore were compelled to anchor outside the harbor in the Choptank River and to discharge and receive their cargoes by means of lighters, can now sail into the harbor as far as the railroad wharf. The freight on these staple articles has been reduced, and the demand for a larger class of vessels is on the increase. It is proposed to expend the amount asked for in completing the approved project.

Cambridge Harbor is in the collection district of Baltimore, which is the nearest port of entry. The amount of revenue collected there during the fiscal year ending June 30, 1892, is $3,178,558.44.

AMOUNTS APPROPRIATED.

By act approved—	
March 3, 1871	$10,000
June 10, 1872	10,000
March 3, 1873	5,000
June 18, 1878	5,000
March 3, 1879	2,500
By act of August 11, 1888	5,000
By act approved September 19, 1890	5,000

Money statement.

July 1, 1891, balance unexpended	$5,081.28
June 30, 1892, amount expended during fiscal year	8.72
July 1, 1892, balance unexpended	5,072.56
Amount appropriated by act approved July 13, 1892	7,737.00
Amount available for fiscal year ending June 30, 1893	12,809.56

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts:		
Raw products	14,270	$118,450
Manufactured products	1,390	58,410
Agricultural products	576	60,631
General merchandise	2,500	100,000
Total	18,736	337,491
Shipments:		
Manufactured products	6,238	381,178
Agricultural products	11,825	363,761
General merchandise	1,500	60,000
Total	19,563	804,939
Total receipts and shipments	38,299	1,142,430

Vessels trading in Cambridge Harbor, Maryland.

Class.	No.	Aggregate tonnage.	Draft.	Trips.
Steamers	4	1,600	*Feet.* 6	Tri-weekly.

The harbor is constantly full of large schooners. The above statistics were furnished by the Maryland and the Choptank River Steamboat Companies of Baltimore.

H 15.

IMPROVEMENT OF WICOMICO RIVER, MARYLAND.

At the beginning of the past fiscal year a contract had been made for the expenditure in dredging of the appropriation of $10,000 made by the river and harbor act of September 19, 1890. Operations were begun on September 26, 1891, and on January 14, 1892, were completed, 65,918 cubic yards of material, principally sand and gravel having been removed under the contract. A channel was dredged to 9 feet below mean low water of a general width of 30 feet, which extended from a point about 100 feet above Goose Island Wharf to the iron county bridge at Salisbury, Md., a distance of 9,250 feet. The material was carried away in scows and deposited in deep holes 7 and 9 miles below Salisbury, respectively.

The adopted project for improvement is based upon a survey made in 1889, and is for a 9-foot channel from the natural 9-foot depth in the river below to the drawbridge at Salisbury, the width of the channel to be 100 feet. The estimated cost of the improvement is $23,200. The work done during the past fiscal year was the first under this project.

It is proposed to expend the amount asked for in completing the project as approved.

Wicomico River is in the collection district of the eastern district of Maryland. Crisfield is the nearest port of entry, and the amount of revenue collected there during the fiscal year ending June 30, 1892, is—

AMOUNTS APPROPRIATED.

By act approved—		By act approved—	
June 10, 1872	$5,000	March 3, 1879	$3,000
March 3, 1873	5,000	June 14, 1880	5,000
June 23, 1874	5,000	March 3, 1881	2,000
March 3, 1875	5,000	July 5, 1884	10,000
August 14, 1876	5,000	September 19, 1890	10,000
June 18, 1878	5,000		

Money statement.

July 1, 1891, balance unexpended	$10,914.63
June 30, 1892, amount expended during fiscal year	10,145.67
July 1, 1892, balance unexpended	768.96
Amount appropriated by act approved July 13, 1892	6,500.00
Amount available for fiscal year ending June 30, 1893	7,268.96
Amount (estimated) required for completion of existing project	6,700.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	6,700.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts:		
Raw products	1,310	$7,350
Manufactured products	28,681	470,290
Agricultural products	1,487	108,290
General merchandise	19,000	760,000
Total	50,478	1,345,930
Shipments:		
Raw products	4,216	12,800
Manufactured products	7,920	198,952
Agricultural products	1,093	49,315
General merchandise	32,090	870,000
Total	45,319	1,131,067
Total receipts and shipments	95,797	2,476,997

Vessels trading in Wicomico River, at Salisbury, Md.

Class.	No.	Aggregate tonnage.	Draft.	Trips.
			Feet.	
Steamers	2	571	6	Tri-weekly.
Schooners	9	Unknown.	6 to 9	Irregular.

A large three-masted schooner is now running regularly with lumber from Suffolk, Va.; also a large number of smaller craft is engaged in a general carrying trade to and from Salisbury.

The above statistics were furnished by the Hon. E. Stanley Toadvin, of Salisbury, Md., and the Maryland Steamboat Company, of Baltimore.

H 16.

IMPROVEMENT OF MANOKIN RIVER, MARYLAND.

There were no operations during the fiscal year ending June 30, 1892. The appropriation made by the act approved September 19, 1890, was expended during the year ending June 30, 1891, in dredging a channel 30 feet wide and 5 feet deep across the "Mud Flats," between Locust Point and Sharp Point, for a total length of 13,515 feet.

The project for improvement adopted in 1890 is for a 6-foot low-water channel 100 feet wide between Locust Point and Sharp Point, embracing the section called the "Mud Flats." The estimated cost is $30,000.

It is proposed to expend the amount asked for in widening the channel already commenced in accordance with the project.

Manokin River is in the collection district of the eastern shore of Maryland. Crisfield is the nearest port of entry, and the amount of revenue collected there during the fiscal year ending June 30, 1892, is $——.

AMOUNT APPROPRIATED.

By act approved September 19, 1890	$7,500

Money statement.

July 1, 1891, balance unexpended	$139.88
June 30, 1892, amount expended during fiscal year	10.80
July 1, 1892, balance unexpended	129.08
Amount appropriated by act approved July 13, 1892	7,500.00
Amount available for fiscal year ending June 30, 1893	7,629.08
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts:		
Bone, coal, cord wood, ship timber, and ice	5,872	$35,483
Bricks, canned goods, fertilizers, flour, etc	4,821	167,811
Grain, hay, horses, potatoes, butter, etc	1,322	34,100
General merchandise	110,000	2,200,000
Total	122,015	2,437,396
Shipments:		
Coal, logs, railroad ties, and ship timber	10,434	91,750
Bricks, canned goods, flour, lumber, and mill work	2,094	59,500
Fruit, grain, hay, poultry, cattle, etc	5,347	179,730
General merchandise	23,000	920,000
Total	40,875	1,250,980
Total receipts and shipments	162,890	3,688,376

Besides one steamer of 4 feet draft making daily trips, there are about 300 schooners, sloops, pungies, etc., engaged in the coastwise trade sailing from the river.

The above statistics were furnished by Mr. H. P. Dashiell, general manager of the Manokin River Steamboat Company.

H 17.

IMPROVEMENT OF ONANCOCK HARBOR, VIRGINIA.

At the beginning of the past fiscal year a contract had been made for the expenditure, in dredging, of the appropriation of $6,000 made by the river and harbor act of September 19, 1890. Operations were begun on July 23, 1891, and were completed September 19 following, the total amount of material removed under the contract being 26,778 cubic yards, which was all fine, white, compact sand. The dredged material was carried away in scows and deposited in deep water in Chesapeake Bay, about 1¼ miles from the work. At the close of operations an examination was made which showed that a channel had been dredged 150 feet wide at the outer bar and another 100 feet wide at the inner bar or Middle Ground, the former about 1,100 feet and the latter about 500 feet in length. The depth made in both channels was 8 feet at low water. It is reported that the offshore end of the channel at the bar has slightly narrowed, from sand moving northward along the shore.

The adopted project is for an 8-foot low-water channel 300 feet wide at the outer bar, and 200 feet wide at the inner bar, called the Middle Ground, at an estimated cost of $12,511. The appropriation just expended was the first one made under the new project.

It is proposed to complete the project with the amount asked for, if appropriated.

Onancock is in the collection district of Cherrystone, Va. Cape Charles City is the nearest port of entry, and the amount of revenue collected there during the fiscal year ending June 30, 1892, is $56.30.

AMOUNTS APPROPRIATED.

By act approved—	
March 3, 1879	$3,000
June 14, 1880	5,000
September 19, 1890	6,000

Money statement.

July 1, 1891, balance unexpended	$5,970.25
June 30, 1892, amount expended during fiscal year	5,875.44
July 1, 1892, balance unexpended	94.81
Amount appropriated by act approved July 13, 1892	6,511.00
Amount available for fiscal year ending June 30, 1893	6,605.81

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts:		
Coal and ice	1,200	$4,800
Bricks, fertilizers, flour, furniture, lumber, etc	3,062	72,650
Butter, grain, hay, horses, and potatoes	939	55,850
General merchandise	5,000	200,000
Total	10,201	333,300
Shipments:		
Barrels, fertilizers, and lumber	1,325	23,600
Fruit, truck, potatoes, eggs, and poultry	1,010	190,032
General merchandise	150	6,000
Total	2,486	219,632
Total receipts and shipments	12,687	552,932

Vessels trading in Onancock Harbor, Virginia.

Class.	No.	Aggregate tonnage.	Draft.	Trips.
			Feet.	
Steamers	4	1,806	6½ to 7	Semiweekly.
Schooners	10	416	5½ to 8	Weekly.

The above statistics were furnished by the Eastern Shore Steamboat Company, of Baltimore.

H 18.

IMPROVEMENT OF HARBOR AT CAPE CHARLES CITY AND APPROACHES BY CHENTON (CHERRYSTONE) INLET, VIRGINIA.

There were no operations during the fiscal year ending June 30, 1892.

The appropriation of $25,000 made by the act approved September 19, 1890, was expended during the previous fiscal year in dredging nearly one-half of the area of the harbor to a depth of 14 feet below mean low water; in dredging the entrance to a depth of 16 feet, the width of the cut at the inner end being 50 feet and at the outer end 480 feet; and in partially removing a shoal to the same depth in Cherrystone Inlet, about 1 mile below the harbor.

The project for improvement adopted in 1890 is for dredging the harbor to a depth of 14 feet below mean low water and the entrance thereto, together with the present channel in Cherrystone Inlet and across Cherrystone Bar, to a depth of 16 feet below the same plane of reference; the channel in the inlet to be 100 feet and that across the bar, 200 feet in width. The original project submitted with the report on the survey made in 1889 included protective works of stone at the entrance, the total cost of the improvement as then estimated being $142,340.

The amount asked for, if appropriated, will be expended in completing the dredging project.

Cape Charles Harbor is in the collection district of Cherrystone, Va. Cape Charles City is the nearest port of entry, and the amount of revenue collected there during the fiscal year ending June 30, 1892, is $56.30.

AMOUNT APPROPRIATED.

By act approved September 19, 1890	$25,000

Money statement.

July 1, 1891, balance unexpended	$3,323.11
June 30, 1892, amount expended during fiscal year	668.67
July 1, 1892, balance unexpended	2,654.44
Amount appropriated by act approved July 13, 1892	10,000.00
Amount available for fiscal year ending June 30, 1893	12,654.44
Amount (estimated) required for completion of existing project	10,400.00
Amount that can be profitably expended in fiscal year ending June 30, 1894	10,400.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

Receipts and shipments.

Class.	Tons.	Value.
Receipts:		
Raw products	976	$11,936
Manufactured products	147,513	1,282.083
Agricultural products	59,231	4,898,606
General merchandise	11,035	441,400
Total	218.755	6,634,025
Shipments:		
Raw products	1,118	31,398
Manufactured products	60.402	6,749,752
Agricultural products	6,944	792,989
General merchandise	31,945	1,277.800
Total	100,409	8,851,939
Total receipts and shipments	319,164	15,485,964

Vessels using Cape Charles Harbor during the year ending December 31, 1891.

Class.	No.	Aggregate tonnage.	Draft.	Trips.
			Feet.	
Steamers	2	1,429	9	Daily.
Tugboats	3	513	11	Do.

The above statistics were furnished by Mr. H. W. Dunne, superintendent of the New York, Philadelphia and Norfolk Railroad Company.

H 19.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

On October 22, 1891, the collector of customs at Baltimore, Md., reported an obstruction to navigation in Sharp Island Narrows, Chesapeake Bay, and the sum of $60 was allotted for the purpose of making an examination thereof. This was done at a cost of $29.64 but as, after a careful search no obstruction was found, no further action was taken and $30.36 were returned to the United States Treasury.

The Treasury Department on December 10, 1891, reported the wreck of the schooner *Harvey W. Anderson*, off Hog Island on the coast of Virginia, as a dangerous obstruction to navigation. After notice to owners and advertisement for proposals bids were opened on February 8, 1892, and a contract for her removal was entered into with Charles W. Johnston, of Lewes, Del., the lowest bidder. He completed the work on March 14, 1892, by blowing up the wreck. The sum of $1,167.79 was expended under allotments of $1,325, $75 of which were for examination, and $157.21 were returned to the Treasury of the United States.

Under date of April 7, 1892, the Superintendent of the U. S. Life Saving Service reported an obstruction on the same coast on which the wreck just mentioned was located. An allotment of $75 was made for examination, and it proved to be the schooner *Ann R. Rogers*, of Cobbs Island, Virginia. A contract was made for her removal on June 10, 1892, with Enoch Townsend, of Somers Point, N. J., the lowest bidder, under an allotment of $1,000. On the 7th of the same month the contractor removed the obstruction by blowing her to pieces with dynamite, the total cost, including expenses of advertising, inspection, etc., being $923.05.

Abstract of proposals opened February 8, 1892, for removal of wreck of schooner Harvey W. Anderson, off Hog Island, Virginia.

No.	Name and address of bidder.	Price.	Amount allotted.
1	Enoch Townsend, Somers Point, N. J.	$1,970	$1,250
2	Charles W. Johnston, Lewes, Del.	935	

Contract (dated February 16, 1892) with Charles W. Johnston.

Abstract of proposals opened May 31, 1892, for removal of wreck of schooner Ann R. Rogers, off Cobbs Island, Virginia.

No.	Name and address of bidder.	Price.	Amount allotted.
1	Charles W. Johnston, Lewes, Del	$1,100	$1,000
2	Joseph D. Truxton, Lewes, Del	1,085	....
3	John W. Chittenden, New York, N. Y	1,190	....
4	W. H. French, Norfolk, Va	840	....
5	Enoch Townsend, Somers Point, N. J	790	....

Contract (dated June 10, 1892) with Enoch Townsend.

H 20.

[Printed in House Ex. Doc. No. 21, Fifty-second Congress, first session.]

PRELIMINARY EXAMINATION OF MURDERKILL RIVER, DELAWARE.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., December 10, 1890.

GENERAL: In compliance with the instructions contained in Department letter of September 20, 1890, and the requirements of section 17 of the river and harbor act of September 19, 1890, I have the honor to submit the following report upon the preliminary examination of Murderkill River, Delaware, made under my direction by Mr. A. Stierle, assistant engineer.

In view of the facts and for the reasons set forth in the report of the assistant, a copy of which is herewith inclosed, Murderkill River, Delaware, is, in my opinion, worthy of improvement, and I recommend a survey of it.

The least amount required to make the survey to include the mouth and extending up the river for a distance of 10 miles, and report with project and estimate of cost of improvement, is $600.

Very respectfully, your obedient servant,

WM. F. SMITH,
United States Agent.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., December 12, 1890.

Respectfully submitted to the Chief of Engineers.

Because of the facts and reasons set forth in the report of December 10, 1890, by the local engineer, and in view of the present and prospective needs of commerce, I have to state, as required by section 18 of the river and harbor act of September 19, 1890, that in my opinion Murderkill River, Delaware, is worthy of improvement by the United States, provided the rights of the Navigation Company, if still existing, to collect tolls, etc., be fully relinquished.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF MR. A. STIERLE, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., December 9, 1890.

SIR: In compliance with your instructions I have the honor to submit the following report upon the preliminary examination of Murderkill River, Delaware.

Murderkill River is in Kent County, Delaware, and flows in a general northeasterly direction into Delaware Bay. Its sources lie near the Maryland State line, and consist of several large fresh-water branches, which unite about 16 miles above the mouth, at Fork Landing, from which point on downward the river assumes the characteristics of a tidal stream. The river is navigable for vessels drawing 5 feet at high water nearly as far as the tide flows. It is rarely, however, that any of them go above the town of Frederica, situated about 11 miles above the mouth of the river.

The course of the Murderkill was formerly a very sinuous one after it leaves the more elevated country at the head. Its bends and reaches were long and shoal, and would often, after flowing a long distance in every conceivable direction, return upon themselves to within a distance of several hundred feet. It was natural, therefore, that in early times those interested in its navigation entertained the idea of shortening the distance by means of artificial cuts connecting the different bends, and for that purpose the Murderkill Navigation Company was formed and chartered by the State of Delaware. Six cuts or canals were made by this company, the first one in 1820, the others at various dates up to 1879. The same company also had a channel dredged across the mud flats at the mouth of the river. The total amount expended by the company was about $10,000. This sum was in return partly recovered by the collection of tolls from all vessels navigating the stream, one of the privileges granted by the charter. These canals were not only made, as said before, to shorten the distance, but, I was told, also for the purpose of avoiding the numerous shoals within certain reaches whose bottom is principally hard clay, difficult to remove. The latter object, though a very plausible one, is the immediate cause why these cuts appear to be rather promiscuously located if their direction with reference to the adjoining bends only is considered.

The result of the six canals, which have an aggregate length of 6,000 feet, has been to shorten the length of the stream about 5 miles and to give a deeper channel. There is now a depth of 5½ feet at low water at the shoalest places in the river, whereas it was formerly only 4 feet. Nevertheless the river is undergoing a gradual deterioration, for the simple reason that several of the old bends have been filled up and the cross sections of the cuts being considerably less than those of the old river, the total capacity of the stream has been reduced in a very large degree. The improvements made by the company, which for the time being appeared to afford relief, indirectly contribute to the eventual destruction of the river for want of a proper understanding of the principles involved in the improvement of tidal rivers. The entrance to the river is obstructed by mud flats extending for a mile from the shore, over which there is a minimum depth of 1 foot at low water. The tide rises about 4½ feet. These flats form the only serious obstruction to navigation, and besides the removal of several shoals inside and a proper rectification of the course of the river, the people interested in the commerce of the Murderkill desire the construction of a new entrance, allowing vessels to pass in and out at all stages of the tide. A 7-foot low-water channel would answer the present needs.

An examination of this stream was made in 1881 under the direction of Col. William Ludlow, Corps of Engineers, and its needs very clearly set forth in a report printed in the Annual Report of the Chief of Engineers for 1882, p. 817 *et seq.* This report presented, besides suggestions for the improvement of the river, several plans for a new outlet. It is understood that no action to carry out this project was subsequently taken, because the right to improve the stream was at that time still vested in the improvement company chartered by the State. Ex-Governor John W. Hall, one of the directors, has informed me that the company has since been dissolved.

The country around the Murderkill is an extremely fertile one, and contains some of the finest farms in the State. It is at present in the center of the peach belt, and the cultivation of this fruit is carried on upon a large scale. Frederica, with a population of about 800, is the only town on the river. It is a thriving business place, with two large canneries, one shipyard, and thirty-eight stores, including those in the country contiguous thereto.

The white-oak timber growing about the headwaters of the Murderkill is considered the best in the State of Delaware, and for years back shipbuilding has been quite an industry at Frederica, the vessels built here being rated first class by the underwriters, on account of their strength, material, and workmanship. A large schooner 175 feet in length was recently launched. From three to four vessels are built every year. Twenty large seagoing schooners are owned here, but do not trade into the river on account of the limited depth of water in the channel and at the mouth. Six light-draft vessels, owned at Frederica, trade regularly in and out of the river, and six transient vessels make irregular trips during the year.

The enterprising spirit of the citizens has been amply shown by the large amount of money expended on their own account for the improvement of navigation. The following commercial statistics, however, illustrate the extent of the present commerce, and may prove the necessity that existed and still exists for these improvements. These statistics were kindly furnished by Mr. Caleb J. Smithers, secretary of a committee of citizens of Frederica, headed by Ex-Governor Hall:

Average amount of trade per annum at Frederica, Del.

Wheat	bushels	100,000
Corn	do	150,000
Peaches, apples, and pears	baskets	500,000
Berries	quarts	1,000,000
Tomatoes, corn, peaches, and pumpkins	cans	2,000,000
Potatoes	baskets	50,000
Cabbage	barrels	1,000
Turnips	baskets	5,000
Timothy and salt hay	tons	500
Wood	cords	2,000
Railroad ties		50,000
Pine and oak piling		7,000
Pine and hemlock timber	feet, B. M	400,000
Oak ship timber	do	500,000
Phosphate	tons	2,000
Coal	do	1,500
Solder	do	30
Stone, brick, and tile	do	150
Tin plate	boxes	7,000
Bar copper	pounds	500
Lime	bushels	50,000
Tomato crates		85,000
Calves and sheep	head	500
Poultry and eggs to the value of		$40,000
General merchandise and agricultural implements to the value of		$200,000

I estimate the cost of a survey to include the mouth and 10 miles of the river at $600.

Very respectfully, your obedient servant,

A. STIERLE,
Assistant Engineer.

Gen. WM. F. SMITH,
United States Agent.

SURVEY OF MURDERKILL RIVER, DELAWARE,

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., December 2, 1891.

GENERAL: In compliance with instructions contained in Department letter dated December 15, 1890, I have the honor to submit the following report upon the survey of Murderkill River, Delaware, made under my direction in accordance with the requirements of the river and harbor act of September 19, 1890.

The streams emptying into the lower part of Delaware Bay from the State of Delaware have, as a general rule, very crooked channels cut through the mud, and are without much of a body of fresh water for their origin. The soil through which they run is generally stiff enough to maintain banks with steep slopes, and the cutting which has been done in the way of improvement is, as a general rule, very durable. Being only arms of the sea, the more the straitening process is applied to them the better they are scoured by the tide. The St. Jones River is an example. There was no tide at Dover, the head of navigation, when the improvement of the river was begun; now the tide is regular and considerable.

The great obstacle at the entrance into Delaware Bay of the Murderkill and other streams is the drifting of the sand of the bay driven against the shore in an inclined direction to the course of the same. This tends, first, to make a large flat along the shore, and second, to drive the mouths of the various streams up or down the bay, according to the direction of the moving sand or to close them entirely when there is no fresh water supply to gather head and force a way through.

The plan for the improvement of the channel of the stream is simple; that for benefiting the mouth is more complicated and not so certain in results. For the Murderkill, from the mouth to Frederica, I would recommend that a channel be cut 80 feet in width and 7 feet in depth at low water. For the improvement of the water way from the mouth of the river into the 7-foot curve in Delaware Bay, I would recommend a cut 250 feet in width at the top with a width of 150 feet at the bottom, the material to be deposited on either side the cut to make an embankment to be at least 2 feet above high spring tides. The cut at the mouth of the St. Jones River gives hopes that such a plan will afford a cheap method of keeping navigation fairly good to the town of Frederica.

The alternative of a jetty seems too expensive for the present or prospective demands of commerce, and the cut proposed can be kept open by a small amount spent in dredging every three or four years.

A copy of the report of Mr. A. Stierle, assistant engineer, accompanies this, and the map* of the survey will be forwarded in a few days.

ESTIMATES.

For work inside the bar at the mouth of the Murderkill:	
Dredging 200,000 cubic yards of material, at 14 cents	$28,000
From the bar to the 7-foot curve in Delaware Bay:	
Dredging 115,000 cubic yards of material, at 17 cents	19,550
Total	47,550

Very respectfully, your obedient servant,

WM. F. SMITH,
United States Agent.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., December 3, 1891.

Respectfully submitted to the Chief of Engineers.

The plan of improvement of the district engineer is recommended for approval. * * *

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

---

* Not printed.

REPORT OF MR. A. STIERLE, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., November 25, 1891.

SIR: I have the honor to submit herewith a report upon the survey of Murderkill River, Delaware, with projects for the improvement of the same.

The report on a preliminary examination, submitted December 10, 1890, contains all the information necessary relating to the benefit that would accrue to commerce and navigation if this river was improved, and I would respectfully refer to it in connection with the present report.

The survey was made during the month of September last, and extended from the bridge at Frederica to the mouth of the river, and along the bay shore for about 1 mile above and below the mouth, inclusive of the off-shore hydrography to the 7-foot depth in the bay. As the town of Frederica forms the present head of navigation for large vessels, the part of the river above the bridge was not included in the survey. The shore and sounding lines within the river were located entirely by stadia measurements, on account of the lack of time and the limited funds.

Two tidal stations were established, one at the wharf at Frederica, the other just inside the mouth of the river. Observations were made at the first-named guage for twenty days, and at the latter for twenty-eight days, covering a lunar month. The average rise and fall of the tide at the mouth of the river for the period of observations was found to be 3.83 feet; at Frederica it was 1.08 feet.

About 4 miles above Frederica, at a point called Fork Landing, the river divides into two large branches. The northerly branch, running principally through a swampy country and named Big Ditch near its extremity, is about 10 miles long. The southerly or Brown's Branch is about 8 miles long. Tidal influence is felt for a distance of about 2¼ miles above the junction of the branches, but is feeble, the average rise and fall being less than 1 foot. The channel depth above Frederica, however, is such that boats of light draft and lighters can and do use it at high water. Not many years ago sailing vessels ran up to Fork Landing, which was then the most prominent shipping point on the river. Competition with other landings further down, a steady increase in the tonnage of the vessels navigating the river, and a slow deterioration of the upper channel finally compelled its abandonment.

The Murderkill, like all the rivers in Delaware flowing through broad marshes, was once unquestionably a large estuary with a powerful tidal volume and a much greater capacity than now. In a reciprocal relation the outlet must have been deeper and wider and was perhaps located further out, nearer the main channel of the bay. The wearing away of the bay shore, which in its retrograde movement eventually shifted the outlet upon a flat fore shore the residue of a former marsh; the gradual growth and closing in of the marshes upon the sides of the river, reducing the width; the upland drainage and its deposits into the river imperceptibly but surely changed the character of the stream, until it has become in proportion to its length the most ill-conditioned river in Delaware.

As a more recent contribution to the deterioration of the river should be added the fruitless efforts that have been made during the past seventy years to improve the navigation by cutting off several long bends separated by narrow strips of land. The sinuosity of these caused the trip from the mouth to the head of navigation to be unusually tedious and laborious. During the period mentioned, six cut-offs or canals were dug, aggregating nearly 10,000 feet, which reduced the distance between the termini over 4 miles, but which reduced the tidal volume and the scouring force as well and that in a much greater proportion. The effects are apparent at the mouth of the river, which is choked by a sand bar, nearly dry at low water, across which the ebb currents are unable to maintain any perceptible channel, notwithstanding that efforts have been made to assist nature by dredging.

Another danger that, with the diminishing scouring power of the river, threatens to close the outlet altogether is the continual transport of sand towards the mouth of the river by the waves along the bay shore south of the entrance. This movement has been observed to take place invariably in the direction indicated, even when winds from an opposite direction prevail. The small cape which is forming on that side is gradually receding up the river, and is projecting more and more into and across the channel, throwing up a dam which, if the opposite shore does not wear away correspondingly, will eventually prevent the tide from going in and the drainage water from going out, making a standing pool of the Murderkill, unless remedial measures are taken. It is the same impending fate that has already overtaken Cedar Creek and Primo Hook Creek, both once navigable streams, with their outlets on the same shore further south.

The distance from the mouth of the river to the bridge at Frederica is, measured along the canals, 47,500 feet, or 9 miles; along the old bends that were cut off it was 70,100 feet, or 13.2 miles, a difference of 4.2 miles, which represents the amount the river was shortened by the canals. The flats outside the mouth of the river are almost bare at low water, and slope very gradually towards deep water in the bay until the 3-foot depth is reached, when the descent becomes steeper. The 6-foot contour lies about three-quarters of a mile from the shore. The entrance to the river is funnel shaped, very narrow at the inner base, where the width from shore to shore is 90 feet, the maximum depth in the channel being 8 feet at low water. Immediately beyond this contraction the width of the river between the banks increases gradually, and averages 150 feet for the next 2¼ miles, the average depth in the channel being 7.8 feet, with maximum and minimum depths of 13.5 and 3.8 feet respectively.

The width of the remaining section of the river as far as Frederica is, with the exception of where canals were made, remarkably uniform, averaging 90 feet. The mean depth decreases slightly before the first canal is reached, but from there up it remains at about the same average of 6.2 feet.

About 20,200 feet above the mouth is the lower end of the first canal, Lowber's, made in 1870. It is 1,300 feet in length and 50 feet in width and has a depth of 9 feet at low water. The length of the bend cut off by this canal is 7,700 feet. This bend is, like the others that were cut off, now gradually filling up, and has a depth of 4 feet at low water.

From the upper end of Lowber's canal to the next, Cole's, is 1,000 feet. Cole's cut, made in 1854, is 1,500 feet long, 43 feet wide, and has a low-water depth of 5¼ feet. The bend it avoided is a short one, 2,700 feet in length, and contained a hard shoal with less than 3 feet of water over it at low tide.

The distance along the river between Cole's canal and the following one is 900 feet. The latter, being the longest of all and therefore commonly called Long Cut, was originally Warren's canal, made in 1830. The upper half was dug in a deflected direction from the lower. Its length is 2,500 feet, the general width 50 feet, and the depth at low water 7.5 feet. This canal shortened the old bed of the river 7,800 feet; the old course is fast filling up.

In continuation of Warren's canal, and just across the river, is the outlet of Walker's canal, made in 1820. Its length is 1,200 feet; its width 55 feet, and the average depth 8 feet. The bend of the river cut off by this canal was 5,200 feet long and has almost entirely closed up, being to-day only a narrow shallow drain.

Opposite the upper end of Walker's canal is Bradley's canal, with a direction slightly turned to the southward. It was dug during the year 1879, comparatively a recent date, and is 1,950 feet long. The average width is 40 feet and the depth of water at low tide 8 feet. About 3,700 feet of the former course of the river were severed from the rest by this cut-off. The bend itself was not extraordinarily crooked and possessed a uniform curvature.

From the upper terminus of this canal to the next and last one happily extends a reach of the river which is 4,600 feet in length. The meanderings of the river begin to lose their great depth and long sweep as they approach the mainland. The uppermost of the canals, the West canal, was excavated in 1853 to avoid a bend in the river 4,700 feet long, which almost returned upon itself. The canal is 675 feet long, 45 feet wide, and has an average depth of 7.5 feet. From this canal up the course of the river is comparatively straight.

The tidal data offer excellent means for arriving at conclusions relative to the condition of a river and generally show the extent to which the unfavorable features of the same can be ameliorated by proper improvements. As the entrance to the St. Jones River is only 3,000 feet above that of the Murderkill and has been recently improved, together with the whole river, a comparison of the tidal observations made at the mouth of the Murderkill with similar observations made at the mouth of the St. Jones nearly three years ago will more fully show the enfeebled state of the tide in the former and assist to verify the deductions previously enumerated in this report.

The time of high water and its rise to a common plane is the same at both rivers. The duration of rise, which is five hours, and of fall, which is a little over seven hours, is also nearly the same; the flood being three minutes shorter and the ebb six minutes longer at the Murderkill. The stands at both low and high water are one-half as long in duration at the St. Jones; indicating a rapid transition from one phase of the tide to the other and a freer waterway for the tide to move in. This last characteristic is further illustrated by a glance at the ebb tide. Whilst in the St. Jones the law of the fall of the ebb tide is represented by a smooth symmetrical curve from one stand to the other, one similarly constructed for the Murderkill is considerably distorted, particularly so during the last hours. For about three and three-fourths hours after high water the tide falls in the same ratio at both gauges. The ebb at the St. Jones then continues to fall in accordance with the usual laws observed, but the ebb in the Murderkill suddenly comes to nearly a stand, falling for the remaining three and one-half hours only five-tenths of a foot, during which time the ebb in the first river has still to go down 1¼ feet to reach its low-water plane. In other words, the low-water plane lies 1 foot lower in the mouth of the St. Jones than in the mouth of the Murderkill, which was verified by a line of levels run between the gauges and by the observations, which give the mean rise and fall 4.8 feet and 3.8 feet respectively.

It is evident that as both estuaries are of about the same length, 21 miles, with surrounding conditions similar in every respect, the St. Jones River is at present the superior receptacle for receiving and holding a large tidal volume. The comparatively small amount of water entering the Murderkill River during the five hours of the flood tide recedes again in the same number of hours, giving the lower section of the river the appearance of a mill race that has been shut off.

In the upper part of the Murderkill River the average depth in the channel is, as stated before, 6.2 feet, yet the tide rises and falls only 1 foot at a point 8 miles above the mouth. By analogy with other Delaware rivers it should not be less than 3 feet at this distance. This clearly proves the retardation of the tide, first, by the shoals at the mouth, and, second, by the narrow canals, which successively throttle it during its progress. Only an inadequate amount of water can get through these gorges during a flood epoch, and I am convinced that Walker's canal is in that respect the most injurious of all, as the old river bed that passed around it and which formerly offered a passageway for the tide is now closed up.

It is obvious that, with the obstructions at the mouth removed, a proper increase given to the width of the artificial canals, and by dredging shoals and by rectifying the shore lines in the upper river, the tidal volume of the river can be increased to such an extent as to add 1 foot to the rise and fall of the tide at the mouth and 2 feet at Frederica. Greater permanency in maintaining a proper channel depth would thereby be insured.

The project herewith submitted is for a 7-foot low-water channel from the 7-foot depth in Delaware Bay to the wharves at Frederica. The proposed cut across the flats at the entrance of the river is about 5,170 feet long, and in order to give it a cross-sectional area of the same size as the average one in the lower part of the river its width has been fixed at 150 feet. It will require the removal of 115,000 cubic yards of material to make this cut. The width proposed for the channel everywhere inside the river is 80 feet. There are shoals that need dredging to the projected depth and all the canals have to be widened, which will require a total of 200,000 cubic yards of dredging.

The cut at the mouth is made to converge towards the cut leading out of the mouth of the St. Jones River, so that in the future both may be brought together in one. A more rational, but also more costly and elaborate project for a new and improved outlet would be to lead the Murderkill River into the St. Jones River by cutting across the intervening neck of land occupied by Bowers Beach village, joining both a short distance above the steamboat wharf. The junction would naturally form a small land-locked harbor for the numerous small vessels and boats plying upon the bay. It would cost less in the end to make and maintain a well-protected single outlet for both rivers as thus outlined, but there is, without any very tangible reason, a very strong local opposition on the part of the people living on the Murderkill side against a united outlet.

It is proposed to deposit all the material to be dredged from the proposed cut along the south side of the same, to form an embankment, that will serve as a nucleus for future protective works. The cut at the St. Jones River will have to be similarly protected on the north side. With the in and out going currents thus confined, it is thought that the formation of a bar at the extreme offshore ends of both cuts can in a great measure be prevented.

ESTIMATE.

200,000 cubic yards of dredging within the river, at 15 cents	$30,000
115,000 cubic yards of dredging at the mouth, at 20 cents	23,000
Total	53,000

Very respectfully, your obedient servant,

A. STIERLE,
Assistant Engineer.

Gen. WM. F. SMITH,
United States Agent.

H 21.

[Printed in House Ex. Doc. No. 57, Fifty-second Congress, first session.]

PRELIMINARY EXAMINATION OF MISPILLION RIVER, DELAWARE, WITH A VIEW OF CUTTING A CANAL SO AS TO SHORTEN THE DISTANCE TO THE BAY, AND MAKING AN OUTLET IN THE BAY WHICH WOULD FURNISH DEEPER WATER.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., November 3, 1890.

GENERAL: In accordance with the instructions contained in Department letter of September 20, 1890, and the requirements of the river and harbor act of September 19, 1890, I have the honor to submit the following report upon the preliminary examination of Mispillion River, Delaware, with a view of cutting a canal so as to shorten the distance to the bay, and making an outlet in the bay which would furnish deeper water.

The tonnage on the river and the shipbuilding interests would seem to require protection; and for the reasons and facts given in the report of the assistant engineer, a copy of which is herewith inclosed, the entrance to Mispillion River, to provide for a navigable channel across the bar which can be used at all stages of the tide is, in my opinion, worthy of improvement, and a survey is recommended.

The least amount required to make the survey and report, with project and estimate of cost of improvement, is $600.

Very respectfully, your obedient servant,

WM. F. SMITH,
United States Agent.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., November 20, 1890.

Respectfully submitted to the Chief of Engineers.

In view of the facts and reasons stated by the local engineer, I agree with him that this river is worthy of improvement by the United States.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF MR. A. STIERLE, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., November 3, 1890.

SIR: In accordance with your instructions I have the honor to submit the following report upon the preliminary examination of Mispillion River, Delaware, with a view of cutting a canal so as to shorten the distance to the bay, and making an outlet in the bay which would furnish deeper water:

Mispillion River forms part of the boundary between Kent and Sussex counties, Delaware. It is a narrow and rather tortuous stream, about 18 miles long, and flows into the Delaware Bay about 17 miles north of Cape Henlopen.

The river (as Mispillion Creek) has been under improvement by the General Government since 1879, the project being for a channel 6 feet deep at low water and 40 feet wide from the town of Milford, the head of navigation, to the mouth. With the exception of a small shoal near the mouth, which requires removal to the projected depth, the project has been completed. The amount expended to date is $17,000. The improvement within the river has been of great benefit to navigation, as all vessels are now enabled to sail without a delay from one end to the other. Nine shoals formerly existed at various points, which during low tides often caused serious and expensive detentions.

The remaining serious obstruction to an open and free navigation in Mispillion River at all stages of the tide is the shallow bar at the mouth. This bar is a physical feature common to all the tributaries of the Delaware Bay, and its existence is due more to the presence of a flat and extensive foreshore projecting far out into the bay, upon which the currents of these streams can make no impression, and to the shifting littoral drift of material carried along the shore during storms than to the deposits of material brought down the rivers. The main channel of the bay is in many cases several miles distant from the shore. The currents along the shore, and especially in the deeper and concave portions, are weak and variable, without a decided set in any one direction; the power of the currents of the tributaries in meeting this neutral region is, therefore, spent and lost, the outlet of these streams assuming a southerly or a northerly direction, depending entirely upon local causes or the prevailing winds and seas.

The difficulty and great expense involved in making a practicable outlet for any of these rivers in Delaware has long been recognized by the Engineer Department. In all cases projects for the improvement of the channel within the streams were made first and the improvement of the mouths was left to a future urgency, though in some cases suggestions were made for a betterment of the present natural conditions. Nearly all the rivers in Delaware of any available size have been under improvement by the General Government during the last fifteen years. The channels therein have now arrived at such a state of completion that the demand for an improved entrance to all of them has become very urgent. It is claimed that an unimproved mouth prevents, in a large measure, the acquisition of a full benefit derived from an improved channel inside the river, and that the utility of the latter is crippled or "bottled up," as it were, so long as these obstructions remain. At two of the rivers coming under this class, at the Christiana and at the St. Jones, the entrance has been improved, and both are now accessible at all stages of the tide. In the case of the latter-named stream this improvement is especially noteworthy, since previously no channel existed at the mouth and vessels could enter and depart only at high water.

The demand for an improved outlet for Mispillion River would seem to have special merits. Outside of the claims of extensive local shipping interests, which largely exceed those of any other river of the same size, there exists at Milford an industry in shipbuilding which deserves recognition. The shipyards at that place are the largest of any on the peninsula south of Wilmington. The vessels built here, all of wood, rate very high with the insurance companies on account of their superiority in material and workmanship. On an average about twelve vessels are built here every year. There were four on the stocks in process of building on the day of my visit—two barges of 350 tons each, one schooner of 400 tons, and one of 750 tons registered burden when finished. The hull of this last vessel is 153 feet long on the keel, 187 feet over all, and has 37 feet beam. Her draft of water will be 15 feet when loaded. It seems almost a matter of impossibility to float such a large hull down and out of a river which has an improved channel only 40 feet in width and many abrupt turns. The shipbuilders state that they have refused many offers to build still larger vessels on account of the difficulty of getting them out of the river and into the channel of Delaware Bay. The delay at the mouth, and expenses contingent thereto often cause a loss of the largest portion of the profits made in building. For similar reasons the shipyards at Milford are cut off from the business of repairing any of the numerous vessels trading up and down Delaware Bay and in adjacent waters, as the risks at the mouth are too great, the branch of repairing and overhauling vessels, it is said, being the most profitable one of the business.

There are seventeen sailing vessels owned by parties living on the Mispillion River, of a total of 1,600 tons burden; the smallest, of 40 tons, has a draft of water of 4 feet; the largest, a 200-ton schooner, draws 7 feet of water. Ten of these vessels trade regularly between points on the river and Philadelphia, and the remaining seven sail regularly to and from New York. Quite a number of transient vessels carry freight in and out of the river. The shipments and receipts by water, consisting principally of lumber, railroad ties, cord wood, grain, canned goods, lime, fertilizers, coal, iron, and general merchandise, amounted during the past year to 44,315 tons, valued at $916,250. All these vessels are subject to long delays at the mouth of the river, where the depth of water over the bar is only 1¼ feet at mean low tide. If the winds are unfavorable and the tides low, the depth at high water is often insufficient to float them across when fully loaded, and lighters have to be resorted to. The difficulties are more complicated when a vessel arrives at the bar and can not enter the river. She is often compelled to wait for days and weeks for a fair tide, and during that time is exposed to all gales from the north to south by east. A schooner drawing 5 feet 7 inches of water was once detained for twenty-two days at the bar by head winds and low tides. Vessel property is in consequence much depreciated and not as profitable an investment as it would be were the mouth of the river improved.

A special survey of the mouth of Mispillion Creek was made during the summer of 1881, under the direction of Capt. W. Ludlow, Corps of Engineers, in compliance with the river and harbor act of March 3, 1881. A project was subsequently submitted for a 4-foot and for a 3-foot low-water channel across the bar, with a single jetty along the northern edge of the proposed channel, at an estimated cost of $55,000 and $49,000, respectively. Although this plan was greatly urged during the following years, it seems that no further action was taken.

It has been recently suggested by persons interested in the navigation of Mispillion River to abandon the lower mile of the river, which has a due southerly course, and to make a new cut across the marsh in a southeasterly direction. Such a cut would shorten the distance several hundred feet and would enable vessels bound up Delaware Bay to depart freely if the wind should be from the south.

There would appear to be some advantage in carrying out these suggested points, but it seems to me that the main obstacle to be dealt with is the flat and shoal bar, which for nearly a mile obstructs the entrance to the river. What improvements are proper and suitable to give Mispillion River a permanent outlet with a channel navigable at all stages of the tide can not be stated until a new survey has been made. This survey should include the hydrography from the 6-foot curve in the bay to the shore for 2 miles above and below the mouth of the river and that of the river for about 1 mile above the light-house. It is estimated that the survey and charts with estimates can be made for $600.

Very respectfully, your obedient servant,

A. STIERLE,
Assistant Engineer.

Gen. W. F. SMITH,
United States Agent.

SURVEY OF MISPILLION RIVER, DELAWARE, WITH A VIEW OF CUTTING A CANAL SO AS TO SHORTEN THE DISTANCE TO THE BAY, AND MAKING AN OUTLET IN THE BAY WHICH WOULD FURNISH DEEPER WATER.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., November 5, 1891.

GENERAL: In compliance with instructions contained in Department letter dated November 22, 1890, I have the honor to submit the following report upon the survey of Mispillion River, Delaware, with a view of cutting a canal so as to shorten the distance to the bay, and making an outlet in the bay which would furnish deeper water, made under my direction in accordance with the requirements of the river and harbor act of September 19, 1890.

A copy of the report of Mr. A. Stierle, assistant engineer, accompanies this, and a tracing of the map* of the survey is forwarded by mail to-day in a separate package.

---

* Not printed.

The commerce of the river does not, in my opinion, justify the outlay of $65,000, the estimate for the third project of the assistant's report, in an improvement which would be constantly needing expenditures to keep it in condition.

I would recommend the cut as laid down on the map, marked C C, because in that position the light-house would serve as a guide to the entrance both for night and day. With the character of the substratum on the shoal, a stiff blue clay, the dredging of a cut giving sufficient material to form a wall of the mud on the upper or northern side of the cut and above the highest tides will probably last for some years and at the end of that time require but a small amount of dredging to keep the necessary width and depth to the channel.

For dredging such a cut the estimate would be 120,000 cubic yards of material at 20 cents per cubic yard, $24,000.

Very respectfully, your obedient servant,

Wm. F. Smith,
United States Agent.

Brig. Gen. Thomas L. Casey,
Chief of Engineers, U. S. A.

(Through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. Engineer Office,
Baltimore, Md., November 6, 1891.

Respectfully submitted to the Chief of Engineers.

The project of the local engineer, as explained in his letter of November 5 and estimated to cost $24,000, is recommended.

Wm. P. Craighill,
Colonel, Corps of Engineers.

REPORT OF MR. A. STIERLE, ASSISTANT ENGINEER.

United States Engineer Office,
Wilmington, Del., October 31, 1891.

Sir: I have the honor to submit herewith a report upon the survey of the mouth of Mispillion River, Delaware, and projects "for cutting a canal so as to shorten the distance to the bay and making an outlet in the bay which would furnish deeper water."

The survey was made during the latter part of August last and extended about one-half of a mile north and 1 mile south of the mouth of the river along the Delaware Bay shore, and for about 1¼ miles up the river. Soundings were taken within the river and for a distance of 1½ miles from the shore. A tide gauge was set up at the light-house landing and referred to a permanent bench mark established at the light-house. Observations of the tide were made for a period of sixteen days. The average rise and fall for that time was found to be 4.02 feet and as the weather was generally fair there were no extraordinary high or low tides to be noted.

According to the wording of the bill the order for the survey is explicit in stating that the object sought is to shorten the distance to the bay and to make an outlet in the bay giving deeper water.

It is not quite clear to me where and how the distance to the bay could be shortened and why this should be done; the necessity for a better outlet in the bay, however, is perfectly apparent.

With regard to the first point it was ascertained that for many years two projects for a cut or a canal towards the bay shore have been discussed by the local savants which were to meet this requirement in a more or less degree. Some proposed a cut from Flat Reach, which is about 1¼ miles above the mouth of the river, across the marsh in an east-southeast direction with an outlet at a point in the bay shore called

"Green Point." It is claimed that an outlet at that point would be less threatened with a closure from the drift sand moving along the shore, and that the shoals located immediately inside the present mouth of the river would be avoided. It is true that such a cut would shorten the distance to the bay about 3,000 feet, but the portion of the river to be sacrificed is in as fair a condition as any other parts of the river, and can be improved with a small expenditure of money. This cut is generally called the "Green Point" project and is marked A A on the accommpanying map. It will be observed that in addition this project, to be of any use, requires a channel or outlet into the bay.

The second plan of improvement discussed is a proposition to make a cut in a northeasterly direction, towards Clarks Point, from a turn in the river 3 miles above the mouth, called Sisters Reach, with an outlet in the beach 2 miles below that point. This cut would be about 3 miles long. Its principal advantage, according to its advocates, would be the location of the entrance in deeper water which here approaches the shore quite closely and is comparatively free from a shallow fore shore. The outlet, however, would nevertheless need protection by jetties. This cut is marked B B on the accompanying sketch of location and is known as the "Clarks Point project."

As will be seen by the estimates given below, both of these projects are pretty costly and the expense of making either of them, to the full width and depth the capacity of the upper river requires, is not commensurate with the advantages gained. It is generally supposed that these cuts could be made of very limited width. This is a serious mistake; for the cross section of a tidal river near the mouth is a measure of its capacity above, and the more the currents are obstructed at the mouth during a tidal epoch the more rapid will be the deterioration of the upper river.

The most economical and expeditious plan to accomplish the needed improvements referred to in the bill would be to utilize the present outlet of the river and to make a cut in a due southeasterly direction across the flats to the 6-foot depth beyond the bar. Six feet at mean low water is thought a sufficient depth for the present demands of navigation. The area of a normal cross section in the river not far above the mouth is at low water a thousand square feet. The cross-sectional area of any cut across the bar can not be less than that. With a depth of 6 feet throughout, the width required at the base of the cut is, therefore, 150 feet. The length of the proposed cut, which is marked C C on the map, is about 5,500 feet. The shoals within the mouth of the river are also to be dredged to the same depth, in conformity with the project of improvement already adopted for the river proper; they are not included in the estimate given below.

It is necessary to protect the proposed cut on both sides, to concentrate the effluent currents and to prevent it being filled up again by drift sand. Especially is the protection needed on the north side, from which direction the movement of sand along the shore predominates, as shown by the long sandy point north of the mouth of the river, which is steadily growing southward, forcing the channel against and down the shore. The extent and the cost of such protective works will in any event be so great that it is imperative to construct them as simple as possible without at the same time endangering their permanency. The plan herewith submitted proposes, as jetties, two embankments, consisting internally of dredged material, forming the core, covered with brush fascines or mattresses 1 foot thick which are weighted down with large-size rubblestone. The top of the embankments is to reach to about high-water level. Borings made at various points across the bar indicate that the material to be excavated in making the proposed cut consists principally of stiff blue clay, a material which long resists the action of the waves.

The jetty on the north side will be contiguous and parallel to the cut. Its construction should be carried on simultaneously with the excavations for the cut. As the shore end near the beach will be particularly exposed to the destructive action of the sea it will be necessary to make that portion quite secure by adding to the mattresses and stone a row of piles closely driven in the center of the embankment for greater stability. The piling should extend from high-water mark to a point 2,000 feet out, and, as shown on the map, the row of piles already driven there years ago is to form a section of it.

The jetty south of the cut projects nearly at right angles from Green Point on the shore, about 2,000 feet below the mouth of the river, and after making a slight deflection southward, about one-half of a mile from the shore, gradually approaches the cut across the bar, and finally runs parallel with the latter for a distance of 800 feet as far as the outer end of the north jetty. As an experiment, it is proposed to build a greater portion of this jetty as a mud embankment only, with dredged material deposited upon the proposed line between the shore and the 2-foot contour. Beyond this depth the remainder is to be similar to the north jetty. The estimate has been made in accordance with this idea.

It has been suggested that the north jetty alone might suffice to protect the cut across the bar; but that is very problematical with such a wide expanse of bay in front of it, and the estimate, therefore, includes a south jetty to make the project complete. During the progress of the work, if once commenced, suggestions as to changes in the details of the project may develop which may permit a considerable reduction in the original estimate. In addition, it may be well to call attention to the fact that the area inclosed by the two jetties will form a valuable and safe harbor for the many small boats engaged throughout the year in fishing and oystering in the bay.

ESTIMATES.

1. Green Point project:	
Dredging a cut 150 feet wide to a depth of 6 feet below mean low water across the marsh from Flat Reach Shoal to the bay shore, a distance of 4,500 feet, 250,000 cubic yards, at 20 cents	$50,000
Add for jetties and cut across the bar, as in project No. 3	65,000
Total	115,000
2. Clarks Point project:	
Dredging a cut 150 feet wide to a depth of 6 feet below mean low water across the marsh from Sisters Reach towards Clarks Point to the 6-foot depth in the bay, a distance of 16,520 feet, 851,105 cubic yards, at 20 cents	170,221
4,000 linear feet of jetties, at $5	20,000
Total	190,221
3. Third project. Improving present mouth of river:	
Dredging a cut 150 feet wide to a depth of 6 feet below mean low water across the bar from the shore to the 6-foot contour, a distance of 5,500 feet, 108,000 cubic yards, at 20 cents	21,600
For jetties on north and south sides of proposed cut—	
15,500 cubic yards of brush mattresses, at $1.40	21,600
15,400 cubic yards of stone, at $1.25	19,300
12,000 linear feet of piling, at 20 cents	2,400
Total	65,000

Very respectfully, your obedient servant,

A. STIERLE,
Assistant Engineer.

Gen. WM. F. SMITH,
United States Agent.

H 22.

[Printed in House Ex. Doc. No. 52, Fifty-second Congress, first session.]

PRELIMINARY EXAMINATION OF SUSQUEHANNA RIVER, ABOVE HAVRE DE GRACE, MARYLAND.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., October 25, 1890.

GENERAL: In accordance with the instructions contained in Department letter of September 20, 1890, and the requirements of the river and harbor act of September 19, 1890, I have the honor to submit the following report upon the preliminary examination of Susquehanna River above Havre de Grace, Md., made under my direction by Mr. A. Stierle, assistant engineer, and a copy of his report is herewith inclosed.

The question of freeing that part of the river from ice gorges, which have produced, and are liable every year to produce, great damage to property, is of great importance, and that section of the stream is, in my opinion, worthy of improvement.

The money already expended in carrying out the project, begun in 1883, of removing the shoal above and to the west of Watsons Island, while it has somewhat benefited the condition of the river, has been spent in too small amounts to be of signal or permanent service.

To get at the subject in a way to propose a project for the proper avoidance of ice gorges requires a comprehensive survey of the river from the rapids above Port Deposit, Md., to the mouth of the Susquehanna below Havre de Grace, which is recommended.

The least amount required to make the survey and report, with project and estimate of cost of improvement, is $3,500.

Very respectfully, your obedient servant,

WM. F. SMITH,
United States Agent.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., November 20, 1890.

Respectfully submitted to the Chief of Engineers.

In view of the facts and reasons stated by the local engineer I agree with him that this river is worthy of improvement by the United States.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF MR. A. STIERLE, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., October 25, 1890.

SIR: In accordance with your instructions I have the honor to submit herewith a report upon the preliminary examination of Susquehanna River above Havre de Grace, Md.

The Susquehanna River above Havre de Grace has been under improvement since 1883. The project consists in the removal of the shoal on the west side of the channel, opposite Watsons Island, to a depth of 8 feet below mean low water, and was made with a view of "facilitating the outflow of ice and to prevent dangerous gorging." The channel at this point is narrow; the shoal referred to appeared to grow in extent; it was therefore proposed to dredge the edge of the shoal on the channel side so as to increase the width of the latter. The shoal has been dredged in accordance with the project in 1883, 1885, 1887, and 1889, and up to date about $32,000 have been expended.

While it is generally supposed that the work done has of late years contributed materially towards a prevention of ice gorges, it is held, nevertheless, that the impression made upon the shoal by dredging under the limited appropriations is too small compared with the size of the shoal, and that the results obtained at the close of each season's operations are too liable to be obliterated upon the occurrence of the next freshet.

On the east side of the river, about 3 miles above the shoal, at Watsons Island and along the steep and rocky cliffs, lies the town of Port Deposit. It is a thriving, prosperous place of about 5,000 inhabitants, and is built along a single street about 1¼ miles long, running parallel with the river. This town has quite a commerce of its own, which, according to a statement furnished, last year reached a total of nearly 300,000 tons in receipts and shipments by water, consisting principally of lumber and granite.

The inhabitants live during the winter under a constant dread of impending danger from ice gorges and their resulting floods, which are known to have risen as high as 18 feet above the common level of the river and have flooded the street and adjoining houses to a height of 7 feet. It is the prevailing opinion among them that since the two railroad bridges have been constructed across the Susquehanna River at and above Havre de Grace, the dangers from ice gorges have increased, and that the ice in going down the river when breaking up, is held back by the piers of these bridges, and in consequence is more liable to pack upon the shoal opposite Watsons Island.

To what extent these real or imaginary obstructions contribute to the ice gorges can only be determined by a survey. The section of the Susquehanna River between Havre de Grace and Port Deposit is the meeting point of the tidal influence from below and the fresh-water inflow from above. The former does not extend more than 1 mile above Port Deposit, and the slope of high and low water must vary but little from a horizontal line. The slope of the river above tide water, however, appears to be quite steep, and it is to be expected that within the section mentioned not only large deposits of sediment carried by the river from above should take place, of which the immense flats below Havre de Grace are sufficient evidence, but that the ice is also here checked suddenly in its descent and lodges, creating the gorges which are so destructive to the adjacent shores and the towns upon them.

It is the desire of the people in this section that a more assured and permanent relief from these dangers should be afforded if it can be had.

This examination has been requested, it seems, solely with reference to the shoal at Watsons Island. No intelligent project for a removal of this obstruction can be made, however, without a clear understanding of the physical conditions of the river, both above and below this island. To suggest remedies for a prevention of ice gorges at the mouth of the Susquehanna would require the planning of a project too costly to be thought of, and is outside the province of this report. The causes that create them can be clearly shown by an extensive survey, and the location and relation of each obstruction and the remedies for the same can be determined after a thorough study of the results of the survey has been made.

This survey should embrace the hydrography of the river from 1 mile above Port Deposit to a point 1 mile below Havre de Grace; a line of levels connecting the elevations of surface slopes both at common tide and freshets, including those of the highest floods known; current observations at several sections in the river, and borings at various points where improvements are likely to be needed.

It is estimated that the survey can be made for $3,500.

Very respectfully, your obedient servant,

A. STIERLE,
Assistant Engineer.

Gen. W. F. SMITH,
United States Agent.

SURVEY OF SUSQUEHANNA RIVER ABOVE HAVRE DE GRACE, MARYLAND.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., December 26, 1891.

GENERAL: In compliance with instructions contained in Department letter dated November 22, 1890, I have the honor to submit the following report upon the survey of Susquehanna River, Maryland, above Havre de Grace, made under my direction, in accordance with the requirements of the river and harbor act of September 19, 1890.

The report on the preliminary examination of this locality was submitted October 25, 1890. This report recommended a survey above and below Havre de Grace for the purpose of ascertaining, from the data acquired thereby, if some project could not be proposed for preventing the ice gorges which occur in that part of the river and generally attended with great loss of property and interruption of commerce.

Under the recommendation of Col. William P. Craighill, Corps of Engineers, U. S. Army, a project was adopted in 1883 for cutting away a shoal on the right bank of the river above Watsons Island, to increase the cross-section of the river there, and tend to prevent the jamming of the ice at that point. Under that project $32,000 have been expended, and the work done has apparently contributed to lessen materially the danger of ice gorges at that point.

Other points of danger, however, exist both above and below where this work was done, and the survey was begun in May and completed in September, 1891. This survey included the river from a point 2 miles above Port Deposit to the light-house on Concord Point, at the town of Havre de Grace.

From the data gained by the surveying party it was established that the ice gorges for the last half century have been formed, (1) at the Penny Shoal near the Concord Point light-house, (2) at two or three points below the town of Port Deposit on the left bank and connecting with the shoal on the right bank of the river upon which the work has been done as referred to above, and (3) at a point of rocks above the town of Port Deposit, called the Hog Back.

The gorges have occurred at the lowest stage of water in the winter and spring, when the ice has been detached from its holding on shore by the warmth of the sun and before a sufficient melting of snow or falling of rain to raise the water of the river to a depth to carry the ice clear of shoals and islands. The ice thus catching on the shoals spreads out on either side, and when two such bodies of ice connect across the river a gorge is formed and then, if not broken, the ice floating down is piled up until the bottom of the river is reached and a dam is formed, and from the backwater of such a dam the destruction to property comes.

The flood tide in the Susquehanna River is not sufficiently strong in velocity or height to break up these gorges by its reactionary effect. The gorges have at times raised the water at Port Deposit 20 feet above mean low water and made the streets impassable except in boats.

To obviate the damaging gorges of ice it would appear that one of two methods, or a combination of both, must be employed. The first is to give a channel of sufficient width and depth to carry off the fields of ice that are moved before the stream is raised by rains and melting snows, and, second, to erect at some suitable point a system of ice-breakers which will break the ice into such small masses as can be taken care of by the river when it is low, or, catching the floating ice, may form a gorge which will not be destructive to property along the river.

The gorges at the Penny Shoal, opposite the Concord light-house at Havre de Grace, will probably be prevented by removing the entire shoal from the piers of the Philadelphia, Wilmington and Baltimore Railroad bridge to the extreme point of the shoal below Havre de Grace, to a depth outside the channel to 8 feet at mean low water and in the channel to a depth of 12 feet at mean low water. This will leave what is called the large shoal to catch the ice, but it is fairly presumable that leaving the channel of the width and depth proposed would leave the whole cross section of the river at that point too wide for any serious damming by a gorge. This would require the removal of 2,654,685 cubic yards of material, at 13 cents per cubic yard, amounting to $345,109.05.

Above Watsons Island and opposite the town of Havre de Grace I would recommend the removal of the shoal on the right bank from a point opposite the town of Port Deposit and near the upper end of Archers Island down to the lowest point at which dredging has been done under the project submitted by Colonel Craighill and carried out since 1883. This work to be carried to a depth of 8 feet below mean low water. Such a project would increase the width of the channel to 3,100 feet, and would ordinarily give a channel of sufficient width and depth to carry the masses of ice into the deep channels on both sides of Watsons Island, where the depth would prevent the ice from grounding and forming a dam. The estimated quantity of material to be removed at this point is 957,405 cubic yards, which, at 13 cents per cubic yard, would cost $124,462.65.

The one other point of danger, as determined by the data furnished by the survey, is at the Hog Back, near the upper end of the rapids above Port Deposit and above tidewater. The river at this point is between banks, at the stage of water found by the survey, 2,820 feet in width, with the bottom full of bowlders and rocks in masses. Here, on the ragged projections called the Hog Back, the ice sometimes lodges, resulting in the formation of a gorge, which, however, overflowing land of little or no value, finds its way back into the bed of the river above Port Deposit without the destruction of property to any extent of more than trifling importance.

A gorge could doubtless be formed across the river at the Hog Back by the building of eight ice-piers, five of them to be on a line with the rocks forming the Hog Back and three above, at proper distances apart, 500 feet above the first line. These would break up the ice and send it down in small fields or retain it, forming a gorge where but little harm would be done to property and where the water would run back into the bed of the river by side channels so as to reënter above the town of Port Deposit. The estimated cost of such piers would be $10,000 each, or in all $80,000. As a combination of dredging and piers it is probable that the removal of the shoal below the Philadelphia, Wilmington and Baltimore Railroad Bridge, together with the piers suggested at the Hog Back, would effect the desired result. The cost of that combination would be as follows:

Dredging 2,654,685 cubic yards, at 13 cents	$345,109.05
Eight piers at $10,000 each	80,000.00
Total	$425,109.05

The map* of the survey is in course of preparation, and will be forwarded as soon as completed.

Very respectfully, your obedient servant,

WM. F. SMITH,
United States Agent.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[*First indorsement.*]

U. S. ENGINEER OFFICE,
Baltimore, Md., December 28, 1891.

Respectfully forwarded to the Chief of Engineers.

Experience in this country and in Europe shows that dealing with ice gorges is a very expensive business, and does not encourage me to hope that the recurrence of gorges in the Susquehanna injurious to Port Deposit can be entirely prevented, but the proposition of the local engineer to transfer the gorge to another point above is an excellent one. The dredging suggested would also be advantageous. A powerful ice-breaking boat to keep the ice broken below Port Deposit and to keep a channel open through the ice would be also a valuable aid.

It should be understood, if this work is to be undertaken by the United States, that it is not for the benefit of navigation.

It is an expensive work, both in first cost and in maintenance. The shoals will surely re-form and require redredging. It would be interesting to know how much an ice gorge actually costs the town of Port Deposit and its inhabitants. It might be found cheaper to let the gorges come, as they do, occasionally, and for the United States to pay the expense entailed each time, rather than to incur a heavy expense for works which will not guarantee protection.

Attempts in Europe to provide a new outlet for running ice and thus prevent gorges, have not been successful, and this method is inapplicable in the case of Port Deposit for topographical reasons. Neither has the use of explosives on gorges already formed been successful.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

---

* Not printed.

H 23.

[Printed in House Ex. Doc. No. 56, Fifty-second Congress, first session.]

PRELIMINARY EXAMINATION OF ROCK HALL HARBOR, MARYLAND.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., November 20, 1890.

GENERAL: In compliance with the instructions contained in Department letter of September 20, 1890, and the requirements of section 17 of the river and harbor act of September 19, 1890, I have the honor to submit the following report upon the preliminary examination of Rock Hall Harbor, Maryland, made under my direction by Mr. A. Stierle, assistant engineer.

In view of the facts and for the reasons set forth in the report of the assistant engineer, a copy of which is herewith inclosed, I consider Rock Hall Harbor, Maryland, worthy of improvement, and recommend a survey of it.

The least amount required to make the survey and report, with project and estimate of cost of improvement, is $500.

Very respectfully, your obedient servant,

WM. F. SMITH,
United States Agent.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., November 22, 1890.

Respectfully submitted to the Chief of Engineers.

This harbor deserves improvement by the United States as much as many other places for which Congress has granted money. In view of the facts and reasons set forth by the local engineer it is considered that this locality is worthy of improvement.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF MR. A. STIERLE, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., November 19, 1890.

SIR: In compliance with your instructions I have the honor to submit the following report upon the preliminary examination of Rock Hall Harbor, Maryland.

Rock Hall Harbor is a small prong or bight on the east side of Chesapeake Bay, extending for about three-fourths of a mile into the Kent County, Md., shore. Its distance from Baltimore, which is situated on the opposite side of the bay, is about 22 miles. The two largest tributaries on the same side of the bay and nearest to Rock Hall Harbor are, north, the Sassafras River, and south, the Chester River, 20 and 11 miles distant, respectively. The general direction of the sheet of water forming the harbor is about southwest and normal to the shore, with two slight turns in the upper and narrower portion. On account of the limited length of the harbor and the broad mouth, which is one-half mile wide, the shore lines on either side approach each other rapidly, and come to a point at the upper end, which is devoid of the usual branch or fresh-water feeder coming from the higher level in the rear. The harbor is therefore not subjected to any filling-in from that source; all the sediment which is precipitated is brought in by the winds and waves, and is comparatively of small amount, so the fishermen in the neighborhood report. The bottom is soft mud, with layers of fine sand, and is quite uniform in depth, as no particularly distinct channel runs through the harbor. The sheltered area is probably one-half of a square mile in extent. Five feet is the prevailing depth of water inside; at the mouth and in the trough of the channel, it is 9 feet at low tide.

About 1¼ miles above Rock Hall Harbor, at Swan Point, the shore of the Chesapeake, which north of this point has a south-southwesterly direction, turns sharply to the eastward for a distance of 1 mile, after which it assumes a general south-southeast direction as far as the mouth of Chester River. From Swan Point as its base extends a bar 3¾ miles long in a south-southeasterly direction, with 1 foot of water over it at the shoalest places. The crest of the bar runs at a distance of 1¼ miles parallel with the adjacent shore and divides the deep water in the bay from that of the subsidiary channel, which opens from below near Chester River and lies close by and follows the shore as far as Rock Hall Harbor and beyond to Swan Creek above. The depth of water in the subsidiary channel varies from 8 to 20 feet.

The peculiar situation of Rock Hall Harbor, under the lee of Swan Point, affords secure shelter against all strong winds and gales, excepting those from the west and south; though even when the latter prevail the outlying bar breaks to a considerable extent the force of the heavy seas and acts like a breakwater. The harbor is therefore well known and much used by all vessels, and especially by the innumerable small sailing craft plying the Chesapeake Bay as a safe harbor of refuge and a convenient place to run into in stress of weather. During revolutionary times it was the landing place of the packet ships which sailed regularly across the bay from Annapolis, and which formed a link in the most direct highway at that time between the North and the South. After the tide of railroad construction set in this harbor was at various times strongly spoken of as a terminus for different railroad lines on the peninsula, and especially on the Eastern Shore, on account of its favorable location and the short distance to Baltimore, both important points when the question of transporting freight and passengers across a wide bay is considered. The Baltimore and Delaware Bay Railroad, which traverses the whole length of Kent County, and another chartered railroad line, which is to begin at Cambridge, in Dorchester County, and which will touch at Easton, Centerville, and Chestertown in following, as near as possible, the eastern shore of the bay, have both signified their intention, so it is stated, to make Rock Hall Harbor the objective point from which connection by water with Baltimore will be made.

At the head of the harbor is situated the village of Rock Hall, with a population of about 800. The place, which was formerly a mere cross-road settlement, has grown considerably of late years, the signs of improvement being everywhere visible. The amount of business done and trade carried on with the surrounding country, which is one of the finest farming regions of Kent County, can best be judged from the fact that there are now located here nineteen stores whose sales amount annually to about $130,000. No manufactories or other special industries are established as yet, excepting a large cannery, which employs several hundred hands during the busy season. The principal occupation of the inhabitants is farming, fishing, and oystering. Besides a large number of boats of small size, under 5 tons burden, there are about thirty vessels ranging from 5 to 40 registered tons, the largest of which has a draft of 8¼ feet, owned at Rock Hall and the adjoining shore. These vessels carry grain, fruit, oysters, fish, and farm produce, and are throughout the year in constant communication with Baltimore.

Mr. George Warfield, president of the Chester River Steamboat Company, has kindly furnished the following additional statistics: * * *

"In the country around Rock Hall seeking an outlet there are forty farms, averaging 225 acres and valued at $360,000. These farms produce annually about—

	Value.
20,000 bushels of wheat	$18,000
25,000 bushels of corn	12,500
100,000 baskets of peaches	50,000
5,000 baskets of apples	2,500
3,000 baskets of pears	1,[illegible]00
50 head of cattle for market	1,[illegible]00
300 calves for market	2,[illegible]00
1,500 lambs for market	6,[illegible]00
6,000 pounds of wool	1,[illegible]00
Butter and eggs	4,[illegible]00
Poultry	3,000
Potatoes	250

"There are about 250 tons of phosphate brought to this place during the year, in addition to large quantities of lime. About 300 families are provided for from fishing and oystering business, and about $90,000 are obtained through work in this direction, to say nothing of the marketable value of the catch."

Rock Hall is considered by the above steamboat company, whose boats stop here twice each day, one of the best shipping points of the line. These boats draw not less than 8 feet of water, which precludes them from Rock Hall Harbor, where the prevailing depth, as stated above, is only 5 feet. For several years the nearest steamboat landing in the vicinity was located at Grays Inn Creek, a small tributary of Chester River, joining the latter about 14 miles above its mouth. This very circuitous route added four hours to the running time of the boats; besides that, the hauling distance to the wharf for all freight to and from the interior was made inconveniently long. Subsequently the company was induced to establish a landing on the Chesapeake side at the mouth of Swan Creek, 1¼ miles north of Rock Hall, where sufficient depth of water could be obtained.

It is the desire of the people at Rock Hall and vicinity to have the harbor dredged to a greater depth than there now exists, so that a landing place could be established which would be nearer the town and more centrally located with reference to the country back of it. The depth required is about 9 feet below mean low water. In view of the small amount of dredging necessary, it would be a comparatively inexpensive improvement, destined to do a great deal of good, not only to the local shipping, but also towards increasing the facilities for anchorage for the numerous vessels seeking refuge here in stormy weather.

Correlative with the expressed desire for an improvement of the harbor, a request has been presented and advocated by other parties to make a cut of sufficient width for sailing vessels across the bar which extends from Swan Point southwardly, in order, first, to relieve all vessels which have to go around this bar from the heavy cross seas to which they are exposed during the prevalence of all high winds blowing on shore, and, second, to give a more direct course across the bay, which would shorten the distance at least 4 miles. While it would appear that this request is of less importance than the one favoring an improvement of the harbor itself, it deserves, nevertheless, some consideration; and if a survey of the harbor is made it should be extended out to the bar and should include that portion of it lying 1 mile south of Swan Point. I estimate the cost of the survey at $500.

Very respectfully, your obedient servant,

A. Stierle,
Assistant Engineer.

Gen. William F. Smith,
United States Agent.

SURVEY OF ROCK HALL HARBOR, MARYLAND.

United States Engineer Office,
Wilmington, Del., September 26, 1891.

General: In compliance with instructions contained in Department letter dated November 25, 1890, I have the honor to submit the following report upon the survey of Rock Hall Harbor, Maryland, made under my direction in accordance with the requirements of the river and harbor act of September 19, 1890.

The project for improvement which is recommended is for a 10-foot low-water channel, 100 feet wide, from the channel in Swan Creek Inlet to the old pier in the harbor, 5,650 feet in length. This would require the removal by dredging of 47,565 cubic yards of material, which, at an estimated cost of 20 cents per cubic yard, would amount to $9,513.

An estimate for a channel across Swan Point Bar, which appears to be desired in connection with the improvement of the harbor, is also given in the report, copy herewith, of Mr. A. Stierle, assistant engineer.

A tracing of the map of the survey is forwarded by mail in a separate package.*

Very respectfully, your obedient servant,

Wm. F. Smith,
United States Agent.

Brig. Gen. Thomas L. Casey,
Chief of Engineers, U. S. A.

(Through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division.)

---

*Not printed.

[First indorsement.]

U. S. ENGINEER OFFICE,
Baltimore, Md., September 30, 1891.

Respectfully submitted to the Chief of Engineers.

Should Congress decide to enter upon this improvement it is recommended that it be on the basis suggested by the United States agent, in his report of September 26, 1891, to the extent of $9,500.

Where the total amount involved is so small it is greatly in the direction of economy that the whole sum be available for a single contract to be executed in one operation.

WM. P. CRAIGHILL,
Colonel, Corps of Engineers.

REPORT OF MR. A. STIERLE, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Wilmington, Del., September 25, 1891.

SIR: I have the honor to submit herewith a report upon the survey of Rock Hall Harbor, Maryland, and a project for the improvement of the same.

For information relating to the benefits to commerce and navigation which would result from the improvement of this harbor I would respectfully refer to the preliminary report submitted on November 20, 1890.

The survey was made during the early part of August last. The most prominent points on the shore around the harbor and Chesapeake Bay, south to Huntingfield Point and north to Swan Point, covering all the portion necessary for the project in view, were fixed by a skeleton triangulation, the intermediary shore line being subsequently filled in with the stadia rod.

Besides the hydrography of the harbor proper, that of Swan Creek Inlet and across Swan Point Bar due west from the harbor was included as far as the 10-foot depth in the bay.

Tidal observations were made for sixteen days on a gauge set in the harbor close by the remnants of an old pier. The average rise and fall of the tide for the sixteen days was found to be 1.10 feet. The greatest range of the tides observed was 2.85 feet, rising 2.22 feet above and falling 0.63 foot below the mean water level. There were no unusually severe meteorological disturbances during the period of observation. The feebleness of the tide is characterized by a long duration of the stands at both high and low water, which in the first case averaged sixty-three and in the latter fifty-six minutes. These, together with the pronounced effects the winds have upon the wide expanse of the bay, causing repeated fluctuations of the water level, though small in magnitude, made it difficult to obtain by simple board-readings the exact time of the middle of the high and low water stands and the mean duration of the flood, which was calculated to be four hours and forty-eight minutes, and that of the ebb, which was determined in the same manner as six hours and forty-eight minutes, can not, therefore, be accepted as very accurate.

In comparing the hydrographic results of the survey with the configuration of the bottom, as given on the Coast Survey chart dating back to probably 1845—the only map available for comparison—there is very little change to be noted as having taken place since that year. The soundings of the present survey give, with the exception of that portion immediately around Swan Point, a slightly increased depth of water everywhere. This may be principally due to the adoption of a different plane of mean low water in both surveys to which soundings were reduced. At any rate it is safe to assume that within the past fifty years the depth of water of this locality has remained unchanged.

There are no indications of any decided accretion in the existing shoals, nor any marked increase or decrease in depth within existing channels. The absence of the generally prevailing tendency in littoral currents to fill up gradually any indentation in the shore line is the more remarkable in the case of Rock Hall Harbor, since the latter, a mere small bight in the shore and devoid of any currents, appears to possess all the characteristics required for its own destruction in the direction indicated. This is, however, with few exceptions, no unusual phenomenon in the smaller prongs of the eastern shore of the Chesapeake Bay, and since, as stated in the preliminary report, Rock Hall Harbor, small as it is, was quite a prominent landing-place one hundred years ago, and has lost since that time none of its qualities that made it desirable for that purpose, it may be inferred that the contemplated improvements, when made, will be permanent for a long time to come.

In conformity with the desire expressed by those interested to establish a landing for large vessels in Rock Hall Harbor which would be nearer the town than the present landing in Swan Creek, a channel 100 feet wide and 10 feet deep at mean low water has been estimated for, and is herewith presented as a project of improvement. This channel is to extend from the 10-foot depth in Swan Creek Inlet to about the site of the former old pier in the harbor. The total length of the cut is about 5,650 feet. The bottom is principally soft and sticky blue mud. It is supposed that the proposed depth of 10 feet is ample for the largest bay steamers and for the larger class of sailing vessels. The remaining area of the harbor can be used, as now, by the smaller fishing and oyster boats.

It remains to refer to the desired channel across Swan Point Bar, of which mention is made in the latter part of the preliminary report. The results of the survey show that the general conditions for dredging such a cut are not as favorable as was previously anticipated. A subsidiary channel across the bar could not be found, but there are several slight depressions about 6 inches lower than the average depth over the crest, which is 2 feet below mean low water. The survey has further developed the fact that Swan Point is now much farther south of its location in 1845, and that it has grown since that year in an almost due southerly direction a distance of about 1,100 feet. As was previously stated, this is the only change noted in comparing the present chart with that of the Coast Survey of older date. It can not be said whether this growth is a periodical or a gradual one, nor can it be foretold with any degree of certainty when and where it will reach its limit of extension. It is sufficient to record that at present its annual movement southward is about 24 feet, and that it may eventually reach, if not arrested by artificial works, any cut made across Swan Point Bar.

For the sake of direction only, the proposed cut, as shown on the accompanying chart, is located in range with the Brewerton Channel, leading out ot the mouth of the Patapsco River, on the opposite side of the bay.

It is of little consequence which direction across the bar is adopted, as in any event no currents prevail here that can be depended upon to keep a dredged channal open, whether the cut is artificially inclosed or not. The frequent passage of vessels, particularly of steamers, would perhaps do more to prevent it from filling up again than anything else that could be devised.

The length of this cut as proposed is about 1 mile. Its width and depth are the same as proposed for the harbor proper, viz, 100 feet and 10 feet, respectively. The distance between Baltimore and this portion of the Kent County shore would be reduced nearly 9 miles by this channel, and not only Rock Hall, but other landings on the adjacent shore, would be benefited if it were made. This portion of the project is, however, only indirectly related to the improvement of Rock Hall Harbor, and the estimate is herewith given parenthetically, and is: 80,000 cubic yards of dredging, at 20 cents per cubic yard; total cost, $16,000.

The proposed project for the improvement of Rock Hall Harbor is a channel 100 feet wide and 10 feet deep at mean low water from the channel in Swan Creek Inlet to the old pier in the harbor.

The estimate is: 47,565 cubic yards of dredging, at 20 cents per cubic yard, $9,513.

Very respectfully, your obedient servant,

A. STIERLE,
Assistant Engineer.

Gen. WM. F. SMITH,
United States Agent.

INDEX.

Subject.	Page. Part I.	Page. Part II.	Page. Part III.	Page. Part IV.
A.				
Agate Bay Harbor, Minn., improvement of	296		2123	
Ahnapee Harbor, Wis., improvement of	307		2184	
Alabama River, Ala., improvement of	200	1418		
Albany, Oregon, construction of bridge across Willamette River by city of	402			
Albemarle and Raleigh Railroad Company, bridge of	408			
Albemarle Sound, N. C., improvement of inland route between Norfolk Harbor, Va., and	152	1094		
Alexandria, Va., construction of bridge across Hunting Creek at	409			
Alger Slough, Wash., construction of bridge of Wahkiakum County across	404			
Allegheny Bridge Company, bridge of	408			
Allegheny River, Pa.:				
Bridge at Oil City, construction of	410			
Bridge at Sixth street, Pittsburg, construction of	408			
Herr Island Dam, construction of	280		1996	
Improvement of	280		1992	
Alloway Creek, N. J., improvement of	118 937			
Altamaha River, Ga., improvement of	177	1261		
Amite River, La., improvement of	217	1485		
Anacostia River, D. C., establishment of harbor lines in	398	1079		
Anacostia River, D. C., examination and survey of	146	1064		
Anacostia River, D. C., improvement of	138	1035		
Anderson, Harvey W. (schooner), removal of wreck of	131 980			
Apalachicola Bay, Fla., improvement of	192	1397		
Apalachicola River, Fla., improvement of	193	1400		
Appomattox River, Va., improvement of	152	1093		
Appoquinnimink River, Del., improvement of	121 950			
Aquia Creek, Va., improvement of	140	1042		
Arkansas River, improvement of	241	1676		
Arkansas River, removal of obstructions in	241	1673		
Arthur Kill, N. Y. and N. J., improvement of	100 860			
Arthur Kill, N. Y. and N. J., modification of harbor lines in	398 861			
Ashland Harbor, Wis., improvement of	299		2137	
Ashley River, S. C., improvement of	174	1229		
Ashtabula Harbor, Ohio, improvement of	351		2508	
Atkins Bay, Me., at Phippsburg, construction of bridge across	405			
Au Sable Harbor, Mich., improvement of	336		2453	
B.				
Back Cove, Portland, Me., improvement of channel in	33 520			
Bagaduce River, Me., improvement of	26 502			
Baldwin Ferry, Miss., construction of bridge across Big Black River at	405			
Ballast, dumping of, in approaches to New York Harbor, and recommendations and proposed legislation to prevent	395		2882	
Baltimore Harbor, Md., improvement of	132	1005		
Bar Harbor, Me., construction of breakwater at	25 500			
Barnstable County, Mass., construction of bridge across Cohasset Narrows by Plymouth County and	404			
Barren River, Ky., operating and care of lock and dam on	290		2074	
Bartholomew Bayou, La. and Ark., improvement of	232	1610		
Bastrop Bayou, Tex., construction of bridge across	409			
Battalion of Engineers	19 475			
Bay City, Wash., construction of bridge across South Bay, Elk River, at	408			
Bay Ridge Channel, New York Harbor, improvement of	93 817			
Bayonne, N. J., modification of harbor lines in front of	398 854			

Subject.	Page.				
	Part I.		Part II.	Part III.	Part IV
Bayou Bartholomew, La. and Ark., improvement of	232		1610		
Bayou Bœuf, La., improvement of	233		1614		
Bayou Courtableau, La., improvement of	219		1500		
Bayou D'Arbonne, La., improvement of	232		1607		
Bayou Lafourche, La., improvement of	217		1487		
Bayou Maçon, La., improvement of	233		1617		
Bayou Manchac, La., improvement of	217		1485		
Bayou Plaquemine, La., improvement of	218		1491		
Bayou Plaquemine, La., prevention of further caving at mouth of	223		1517		
Bayou Rondeway, La., improvement of	234		1620		
Bayou Teche, La., improvement of	220		1503		
Bayou Teche, La., removal of wreck in	223		1513		
Bayou Terrebonne, La., improvement of	218		1490		
Bayou Vidal, La., improvement of	234		1620		
Beaufort Harbor, N. C., improvement of	161		1137		
Beaufort, N. C., improvement of inland waterway between New River and	162		1141		
Beaufort, N. C., improvement of inland waterway between Newbern and	161		1134		
Beaufort River, S. C., improvement of	175		1238		
Beaver River, Pa., construction of movable dam in Ohio River below mouth of	278			1983	
Belfast Harbor, Me., improvement of	28	507			
Bellamy River, N. H., improvement of	36	528			
Bellingham Bay, Wash., establishment of harbor lines in	399			2794	
Big Black River, Miss., at Baldwin Ferry, construction of bridge across	405				
Big Black River, Miss., improvement of	234		1622		
Big Hatchee River, Tenn., improvement of	238		1657		
Big Hocking River, Ohio, improvement of	277			1964	
Big Sandy River, improvement of Levisa Fork of, Ky	293			2108	
Big Sandy River, improvement of Tug Fork of, W. Va. and Ky	294			2109	
Big Sandy River, W. Va. and Ky., improvement of	293			2098	
Big Stone Lake, Minn. and S. Dak., examination and survey of	262		1853		
Big Sunflower River, Miss., improvement of	238		1654		
Bills to authorize construction of bridges, examination of	21				
Biloxi Harbor, Miss., improvement of	212		1458		
Black Creek Shoal, Lake Ontario, survey of	420				3428
Black Lake Harbor, Mich., improvement of	327			2348	
Black River, Ark. and Mo., improvement of	245		1689		
Black River Harbor, Ohio, improvement of	349			2501	
Black River, La., improvement of	231		1602		
Black River, Mich., at Port Huron, improvement of	339			2469	
Black River, Mich., improvement of mouth of	330			2471	
Black River, Mo., improvement of	246		1691		
Black River, N. C., improvement of	164		1154		
Black Rock Harbor, Conn., improvement of	75	689			
Black Warrior River, Ala., between Tuscaloosa and Daniels Creek, improvement of	206		1440		
Block Island, R. I., improvement of harbor of refuge at	63	630			
Blood River, La., improvement of	216		1484		
Bluff Creek, Miss., improvement of	211		1457		
Board of Engineers, The:					
Members	16				
Members, additional duties of	18				
Personal inspections	17				
Reports rendered	16				
Boards, examinations by:					
Delaware Bay, harbor of refuge near mouth of	119	941			
Hudson River, N. Y	85	750			
Pacific coast, deep harbor between Points Dume and Capistrano, Cal	370			2630	
Ship canal to connect lakes Union, Washington, and Samamish with Puget Sound, Wash	385			2762	
Bœuf Bayou (or River), La., improvement of	233		1614		
Bogue Chitto, La., improvement of	214		1466		
Bogue Falia, La., improvement of	215		1481		
Bogue Sound, N. C., improvement of	162		1141		
Boston Bridge Company, bridge of	408				
Boston Harbor, Mass., improvement of	46	575			
Boston, Mass.:					
Bridge between Q street and Castle Island, construction of, by park commissioners	402				
Bridges across Charles River at Market and Arsenal streets, reconstruction of, by city of	407				
Fortifications for defense of	4				
Mining casemates at	9				

Subject.	Page. Part I.	Part II.	Part III.	Part IV.
Boston, Pa., construction of bridge across Youghiogheny River at	408			
Bourne, Mass., construction of bridge across Cohasset Narrows at town of	404			
Brady, Agatha (canal boat), removal of wreck of	119 940			
Brandywine Creek at Wilmington, Del., construction of bridge across	400			
Brazoria County, Tex., construction of bridges across Bastrop and Chocolate bayous by	409			
Brazos River, Tex., below Waco, examination of	228	1555		
Brazos Santiago Harbor, Tex., improvement of	227	1553		
Breakwaters, etc., occupancy or injury of	22 413			3341
Breton Bay, Md., improvement of harbor at	141	1045		
Bridgeport Harbor, Conn., improvement of	74 685			
Bridges across navigable waters, construction of	21 400			3315
Bridges, examination of bills to authorize construction of	21			
Bridges obstructing navigation	21 410			
Bristol Landing, Md., construction of bridge across Patuxent River near	405			
Broadkiln River, Del., improvement of	123 955			
Brooklyn, N. Y., bridge obstructing Newtown Creek, at Meeker avenue	411			
Brooks Slough, Wash., construction of bridge of Wahkiakum County across	404			
Browneys Island, Me., removal of wreck off	39 533			
Browns Creek, N. Y., improvement of	83 727			
Bruce (bark), removal of wreck of	223	1513		
Brunswick Harbor, Ga., improvement of	179	1278		
Brunswick Outer Bar, Ga., examination and survey of	182	1327		
Buckhannon River, W. Va., improvement of	295		2119	
Budds Inlet, Wash., examination and survey of Olympia Harbor to deep water in	384		2733	
Buffalo Bayou, Tex., at Houston, bridges obstructing	412			
Buffalo Bayou, Tex., improvement of	227	1548		
Buffalo Bluff, Fla., reconstruction of bridge across St. Johns River at	407			
Buffalo Harbor, N. Y., improvement of	354		2529	
Buildings and grounds, public, improvement and care of	418			3385
Burlington Harbor, Vt., improvement of	364		2609	
Buttermilk Channel, New York Harbor, improvement of	92 814			
C.				
Cache River, Ark., improvement of	244	1687		
Cahaba River, Ala., improvement of	204	1432		
Calcasieu River, La., improvement of mouth and passes of	220	1504		
California, department of, report of engineer officer	424			3459
Caloosahatchee River, Fla., improvement of	187	1377		
Calumet Harbor, Ill., improvement of	316		2245	
Calumet River, Ill. and Ind., improvement of	317		2249	
Cambridge Harbor, Md., improvement of	127 973			
Camden Harbor, Me., improvement of	28 509			
Camden Horse Railroad Company, bridge of	412			
Camden, N. J., bridge of, obstructing Coopers Creek	412			
Camden, N. J., improvement of harbor at	112 906			
Camp, Hugh N., and D. E. Seybel, bridge of	406			
Canals, etc.:				
Allegheny River, construction of Herr Island Dam, Pa	280		1996	
Cascades Canal, Columbia River, Oregon, construction of	388		2819	
Coosa River, Ga. and Ala., operating and care of locks and dams on	204	1431		
Des Moines Rapids Canal and Dry Dock, operating and care of	255	1773		
Fox River, Wis., operating and care of locks and dams on	315		2222	
Great Kanawha River, W. Va., operating and care of locks and dams on	287		2062	
Green and Barren rivers, Ky., operating and care of locks and dams on	290		2074	
Illinois and Mississippi Canal, Ill., construction of	320		2297	
Illinois River, Ill., operating and care of La Grange Lock and Dam	319		2294	
Kentucky River, Ky., operating and care of locks and dams on	292		2091	

Subject.	Page. Part I.	Page. Part II.	Page. Part III.	Page. Part IV.
Canals, etc.—Continued.				
Lakes Union, Washington, and Samamish, with Puget Sound, Wash., examination for a ship canal to connect	385		2762	
Little Kanawha River, W. Va., operating and care of lock and dam on	295		2117	
Louisville and Portland Canal, Ky., operating and care of	284		2024	
Monongahela River, operating and care of Locks and Dams Nos. 8 and 9	279		1986	
Monongahela River, purchase of Lock and Dam No. 6	279		1990	
Monongahela River, purchase of Lock and Dam No. 7	279		1989	
Muscle Shoals Canal, Tennessee River, operating and care of	275	1956		
Muskingum River, Ohio, operating and care of ice-harbor lock at mouth of	281		1998	
Muskingum River, Ohio, operating and care of locks and dams on	282		2000	
Ohio River, construction of movable dam below mouth of Beaver River, Pa	278		1983	
Ohio River, operating and care of Davis Island Dam, Pa	277		1980	
Portage Lake and Lake Superior canals across Keweenaw Point, Mich., improvement and operating and care of	302		2158	
Rules and regulations for use of, recommendations and proposed legislation for establishment and enforcement of	22			
St. Clair Flats Canal, Mich., improvement of	340		2173	
St. Clair Flats Canal, Mich., operating and care of	341		2475	
St. Marys Falls Canal, Mich., operating and care of	332		2426	
Canapitsit Channel, Mass., examination and survey of	66 645			
Canarsie Bay, N. Y., improvement of	98 866			
Canarsie Bay, N. Y., use of dike in				332
Caney Fork River, Tenn., improvement of	272	1941		
Cape Ann, Mass., construction of harbor of refuge at Sandy Bay	42 558			
Cape Charles City, Va., improvement of harbor and approaches of	130 979			
Cape Fear, Northeast, River, N. C., improvement of	164	1152		
Cape Fear River, N. C., above Wilmington, improvement of	165	1158		
Cape Fear River, N. C., at and below Wilmington, improvement of	165	1164		
Capistrano, Point, Cal., and Point Dume, Cal., examination for deep harbor on Pacific coast between	370		2680	
Cascades Canal, Columbia River, Oregon, construction of	388		2819	
Casemates, mining, construction of	8			
Casper River, Ky., near its mouth, bridge obstructing	411			
Castle Island, Boston Harbor, Mass., construction of bridge between Q street, Boston, and	402			
Cedar Bayou, Tex., improvement of	227	1543		
Cedar Keys Harbor, Fla., improvement of	191	1392		
Cedar River Harbor, Mich., improvement of	303		2172	
Champlain, Lake, breakwater at Gordon Landing, Vt.	363		2606	
Champlain, Lake, breakwater at Rouse Point, N. Y.	363		2604	
Champlain, Lake, N. Y. and Vt., improvement of narrows of	365		2614	
Charles River, Mass., at Market and Arsenal streets, Boston, reconstruction of bridges across	407			
Charles River, Mass., improvement of	47 579			
Charleston Harbor, S. C., improvement of	173	1219		
Charleston, S. C., construction of mining casemate at	8			
Charlevoix Harbor, Mich., improvement of	322		2315	
Charlotte Harbor, Fla., improvement of	187	1379		
Charlotte Harbor, N. Y., improvement of	367		2551	
Charlotte Harbor, N. Y., injuries to piers at				[illegible]
Charts of Northern and Northwestern lakes, correction, printing, and distribution of	419			[illegible]
Chatham Harbor, Mass., improvement of	51 595			
Chattahoochee River, Ga. and Ala., improvement of	195	1405		
Cheat River, W. Va., improvement of	279		1991	
Cheboygan Harbor, Mich	334		2448	
Chefuncte River, La., improvement of	215	1481		
Chehalis County, Wash., construction of bridge across Chehalis River at Elbow Riffle by	405			
Chehalis County, Wash., construction of bridge across South Bay, Elk River, between Bay City and Laidlaw, by	408			

SUBJECT.	Page.			
	Part I.	Part II.	Part III.	Part IV.
Chehalis River, Wash., at the Elbow Riffle, construction of bridge across	405			
Chehalis River, Wash., improvement of	382		2726	
Cherry Island Marsh Company, bridge of	400			
Cherrystone Inlet, Va., improvement of	130 979			
Chesapeake Bay, examination and survey for harbor of refuge in Lynnhaven Bay, Va., at foot of	147	1076		
Chester River, Md., improvement of	126 970			
Chicago and North-Western Railway Company, bridge of	409			
Chicago and West Michigan Railway Company, bridge of	411			
Chicago Harbor, Ill., improvement of	315		2237	
Chicago, Ill., construction of bridge across West Fork of South Branch of Chicago River on Southwest Boulevard by city of	406			
Chicago, Ill., resurvey of lake front at	420			3427
Chicago, Milwaukee and St. Paul Railway Company, bridge of	403 404			
Chicago, Peoria and St. Louis Railway Company, bridge of	409			
Chicago River, Ill., construction of bridge across West Fork of South Branch of	406			
Chickahominy River, Va., improvement of	151	1091		
Chickasahay River, Miss., improvement of	211	1456		
Chief of Engineers, office of the	425			
Chincoteague Bay, Va., improvement of inland waterway between Delaware Bay and	123 956			
Chippewa River, Wis., at Durand, bridge obstructing	412			
Chippewa River, Wis., including Yellow Banks, improvement of	258	1833		
Chippewa River, Wis., near Red Cedar, reconstruction of bridge across	404			
Chippewa River, Wis., surveys for reservoirs at sources of		1849		
Chippewa Valley Bridge Company, bridge of	412			
Chitto, Bogue, La., improvement of	214	1460		
Chocolate Bayou, Tex., construction of bridge across	409			
Choctawhatchee River, Fla. and Ala., improvement of	197	1409		
Choptank River, Md., improvement of	127 972			
Christiana River, Del., in New Castle County, reconstruction of bridge across	401			
Christmas Point, Tex., examination and survey of West Bay and Oyster Bay, near	228	1563		
Cincinnati and Covington Rapid Transit Company, bridge of	407			
Cincinnati, Ohio, construction of bridge across Ohio River at	407			
Clackamas Rapids, Oregon, examination and survey of Willamette River at	393		2840	
Clarendon, Ark., examination and survey at	247	1697		
Clark River, S. C., improvement of	171	1206		
Clatsop County, Oregon, construction of bridge across Walluski River by	400			
Cleveland Harbor, Ohio, improvement of	349		2503	
Clinch River, Tenn., improvement of	269	1925		
Clinton Harbor, Conn., improvement of	71 667			
Clinton River, Mich., improvement of	341		2477	
Clubfoot River, N. C., improvement of	161	1134		
Coaster Harbor Island, R. I., improvement of cove and waterway near	60 624			
Cobbs Island, Va., removal of wreck off	131 980			
Cocheco River, N. H., improvement of	37 529			
Cohasset Narrows, Mass., construction of bridge of Plymouth and Barnstable counties across	404			
Columbia, department of the, report of engineer officer	424			3458
Columbia River, Oregon and Washington:				
Cascades Canal, construction of	388		2819	
Examination and survey of, between mouth of Willamette River and Vancouver	395		2865	
Examination and survey of Willamette and Columbia rivers below Portland, for 25-foot channel	394		2850	
Gauging	393		2839	
Harbor lines at Vancouver, establishment of	399		2794	
Improvement of, between head of Rock Island Rapids and foot of Priest Rapids	381		2716	
Improvement of Columbia and Willamette rivers below Portland	389		2829	
Improvement of mouth of	386		2808	
Improvement of upper river	380		2709	
Survey of upper river			2721	

Subject.	Page. Part I.	Part II.	Part III.	Part IV.
Columbiana, Ill., construction of bridge across Illinois River at	401			
Commencement Bay, Wash., at Tacoma, bridge obstructing	412			
Compton Creek, N. J., improvement of	108 892			
Conecuh River, Fla., improvement of	199	1416		
Congaree River, S. C., improvement of	173	1217		
Conneaut Harbor, Ohio, examination and survey of	352		2515	
Connecticut River:				
Improvement of	68 656			
Improvement of, above Hartford, Conn	68 657			
Improvement of, below Hartford, Conn	69 658			
Contentnia Creek, N. C., improvement of	158	1123		
Cooper River, S. C., removal of wrecks in	175	1240		
Coopers Creek, N. J., at Camden, bridge obstructing	412			
Coos Bay, Oregon, improvement of entrance and harbor at	376		2669	
Coosa River, Ga. and Ala.:				
Improvement of	202	1424		
Improvement of, between Rome, Ga., and East Tennessee, Virginia and Georgia Railroad bridge	202	1424		
Improvement of, between Wetumpka, Ala., and East Tennessee, Virginia and Georgia Railroad bridge	203	1428		
Operating and care of locks and dams on	204	1431		
Coquille River, Oregon, improvement of	375		2662	
Coronado, Cal., establishment of harbor lines at	399		2640	
Coronado North Island, Cal., establishment of harbor lines at	399		2640	
Corps of Engineers:				
Changes during the year	3			
Distribution of officers	3			
Laws of 52d Congress, 1st session, affecting				3453
Number of officers	3			
Officers detached	4			
Statement of rank and duties of officers	427			
Corvallis, Oregon, examination and survey of Willamette River near	393		2840	
Courtableau, Bayou, La., improvement of	219	1500		
Covington, Ky., construction of bridge across Licking River at	404			
Covington, Ky., construction of bridge across Ohio River at	407			
Cowlitz River, Wash., at Toledo, construction of bridge across	401			
Cowlitz River, Wash., improvement of	392		2837	
Crookston, Minn., examination and survey of Red River of the North and tributaries above	262	1853		
Crossover Light, St. Lawrence River, N. Y., removal of shoals near	362		2509	
Cumberland River, Tenn. and Ky., improvement of	270	1927		
Above mouth of the Jellico	272	1939		
Above Nashville, Tenn	270	1931		
Below Nashville, Tenn	270	1928		
South Fork of, Ky	273	1943		
Cumberland Sound, Ga., improvement of	180	1286		
Currituck County, N. C., bridge of, obstructing Tulls Creek	411			
Currituck Sound, N. C., improvement of	152	1094		
Cuttyhunk Island, Mass., examination and survey of Canapitsit Channel, near	66 645			
Cuyahoga River, Ohio. (*See* Cleveland Harbor.)				
Cypress Bayou and lakes between Jefferson, Tex., and Shreveport, La., survey of	240	1668		
D.				
Dams and locks. (*See* Canals.)				
D'Arbonne, Bayou, La., improvement of	232	1607		
Darien Harbor, Ga., improvement of	177	1257		
Darien Harbor, Ga., removal of wrecks in	180	1292		
Davids Island, New York Harbor, sea wall and embankment at	12 457			
Davis Island Dam, Ohio River, Pa., operating and care of	277		1980	
De Pere, Wis., construction of bridge across Fox River and Government canal at	409			
Delaware Bay:				
Delaware Breakwater	116 933			
Harbor of refuge near mouth of, examination for	119 941			
Ice harbor at head of, construction of	115 930			
Lewes, Del., construction of iron pier near	115 931			

SUBJECT.	Page. Part I.	Part II.	Part III.	Part IV.
Delaware Bay—Continued:				
Waterway between Chincoteague Bay, Va., and, improvement of	123 956			
Delaware Breakwater, Del., improvement of	116 933			
Delaware Railroad Company, bridge of	401			
Delaware River, Pa. and N. J., at Philadelphia, improvement of	112 906			
Delaware River, Pa. and N. J., improvement of	110 900			
Delaware River, Pa. and N. J., removal of wreck at Philadelphia	119 940			
Department of California, report of engineer officer	424			3459
Department of the Columbia, report of engineer officer	424			3458
Department of the Missouri, report of engineer officer	424			3457
Department of the Platte, report of engineer officer	424			3459
Departments, military, reconnoissances, explorations, and surveys in	424			3457
Depot, Engineer	19 479			
Des Chutes River, Wash., near Olympia, examination of	384		2733	
Des Moines Rapids Canal and Dry Dock, operating and care of	255	1773		
Des Moines Rapids, Mississippi River, improvement of	254	1772		
Detroit River, Mich., improvement of	343		2181	
District of Columbia, improvement and care of public buildings and grounds	418			3385
District of Columbia, water supply of	416			3380 3381
Division engineers	22			
Divisions, engineer	22			
Doboy, Ga., and Sapelo, Ga., examination and survey of inside route between	181	1294		
Dry dock at St. Marys Falls Canal, Mich	323		2443	
Dry dock, Des Moines Rapids, operating and care of	255	1773		
Duck Island Harbor, Conn., improvement of	70 664			
Duluth Harbor, Minn., construction of bridge of city of Duluth across canal at entrance of	410			3315
Duluth Harbor, Minn., improvement of	297		2126	
Duluth, Minn., construction of bridge across canal at entrance of Duluth Harbor by city of	410			3315
Duluth, Red Wing and Southern Railroad Company, bridge of	403			
Dume, Point, Cal., and Point Capistrano, Cal., examination for deep harbor on Pacific coast between	370		2630	
Dumping of ballast in approaches to New York Harbor, and recommendations and proposed legislation to prevent	395		2882	
Dunkirk Harbor, N. Y., improvement of	353		2527	
Durand, Wis., bridge obstructing Chippewa River at	412			
Duwamish River, Wash., construction of bridge across	400			
E.				
Eagle Harbor, Mich., improvement of	300		2141	
East Chester Creek, N. Y., improvement of	79 708			
East River, N. Y., establishment of harbor lines in	398 849 859			
East River, N. Y., improvement of	90 797			
Eastern Branch of the Potomac. (*See* Anacostia River.)				
Ebey Slough, Wash., construction of bridge across	400			
Echo Harbor, New Rochelle, N. Y., improvement of	79 706			
Edgartown, Marthas Vineyard, Mass., improvement of inner harbor at	53 602			
Edisto River, S. C., improvement of	174	1233		
Elbow Riffle, Wash., construction of bridge across Chehalis River at	405			
Elizabeth River, N. J., improvement of	103 878			
Elizabeth River, Va., modification of harbor lines at Norfolk navy-yard, in South Branch of	399	1097		
Elk River, Ala., at Elk River Mills, construction of bridge across	402			
Elk River, Md., improvement of	125 968			
Elk River Mills, Ala., construction of bridge across Elk River at	402			
Elk River, Wash., construction of bridge across South Bay	408			
Elk River, W. Va., improvement of	287		2064	
Elk River, W. Va., obstructions in				3343
Engineer depot	19 479			
Engineer divisions	22			
Engineer school, United States	19 474			
Engineers, battalion of	19 475			
Engineers, Chief of, office of the	425			

Subject.	Page. Part I.	Page. Part II.	Page. Part III.	Page. Part IV.
Engineers, Corps of. (*See* Corps of Engineers.)				
Engineers, division	22			
Engineers, The Board of. (*See* Board of Engineers, The.)				
Erie Harbor, Pa., improvement of	352		2522	
Erie Harbor, Pa., preservation and protection of Presque Isle Peninsula	353		2526	
Erie, Lake, survey of shoals off Pelée Spit Lighthouse, Littles Point, and Waverly Shoal	420			3407 3424
Erie, Lake. (*See also* Northern and Northwestern lakes.)				
Escambia River, Fla., improvement of	199	1416		
Estimates:				
Engineer depot	20 484			
Fortifications	15			
Mississippi River Commission	396			2903
Missouri River Commission	397			3254
New York Harbor, supervision of	395		2882	
Northern and Northwestern lakes, charts and surveys of	421			3414
Public buildings and grounds and Washington Monument, Washington, D. C	418			3409
River and harbor improvements	21			
Surveys and reconnoissances, and publication of maps	425			3457
Washington Aqueduct	415			3376
Yellowstone National Park, construction and improvement of roads and bridges in	423			3439
Everett, Wash., construction of bridge across Snohomish River at	406			
Everett, Wash., Land and River Improvement Company of, bridge of	406			
Explorations and reconnoissances	424			3457
F.				
Fairhaven, Wash., establishment of harbor lines at	399		2794	
Fairlee Creek, Md., improvement of	126 969			
Fairport Harbor, Ohio, improvement of	350		2506	
Fairport Harbor, Ohio. (*See also* Grand River.)				
Falia, Bogue, La., improvement of	215	1481		
Falls of Ohio River, improvement of	283		2015	
Falls of Ohio River, improvement of Indiana Chute	283		2020	
Feather River, Cal., improvement of	372		2652	
Fellows, Bertha J. (schooner), removal of wreck of	66 641			
Fergus Falls, Minn., examination and survey of Red River of the North and tributaries above	262	1853		
Fernandina, Fla., and Savannah, Ga., examination and survey of inside route between	181	1309		
Ferndale, Wash., construction of bridge across Nooksack River at	408			
Fishing Creek, N. C., improvement of	157	1117		
Fish ways at Great Falls, Potomac River, erection of	417			3383
Five-Mile River Harbor, Conn., establishment of harbor lines at	398 730			
Five-Mile River Harbor, Conn., improvement of	76 697			
Flint River, Ga., improvement of	194	1402		
Flushing Bay, N. Y., improvement of	82 722			
Forked Deer River, Tenn., improvement of	239	1660		
Fort Bayou, Miss., at Ocean Springs, construction of bridge across	402			
Fortifications	4			
Allotments	4			
Appropriations	4			
Estimates for 1893-'94	15			
Mining casemates	8			
Sites for, acquisition of	9			
Fourche le Fevre River, Ark., improvement of	243	1681		
Fox River, Wis:				
Bridge across Portage Canal, reconstruction of	403			
Bridge at De Pere across Government canal and, construction of	400			
Bridge at Oshkosh, construction of	403			
Improvement of	314		2213	
Operating and care of locks and dams on	315		2222	
Frankfort County, Ky., bridge of, obstructing Kentucky River	411			
Frankfort Harbor, Mich., injury to Government scow at				3344
Frankfort, Ky., bridge of city of, obstructing Kentucky River	411			
Frankfort, Mich., improvement of harbor at	322		2318	
Franklin, La., removal of wreck near	223	1513		
French Broad River, Tenn., improvement of	268	1922		

SUBJECT.	Page.			
	Part I.	Part II.	Part III.	Part IV.
G.				
Galveston Bay, Tex., improvement of ship channel in	225	1536		
Galveston County, Tex., construction of bridge across West Bay by	407			
Galveston Harbor, Tex., improvement of entrance to	224	1523		
Galveston, Tex., examination and survey of West Bay from Christmas Point, near	228	1563		
Gandy, Edith T. (schooner), removal of wreck of	66 640			
Gasconade River, Mo., improvement of	251	1739		
Gasper River, Ky., near its mouth, bridge obstructing	411			
Gauley River, W. Va., construction of bridge across	408			
Gauley River, W. Va., improvement of	288		2007	
Georgetown Harbor, S. C., improvement of	168	1183		
Glen Cove Harbor, N. Y., improvement of	82 720			
Gloucester Harbor, Mass., improvement of	43 506			
Gordon Landing, Lake Champlain, Vt., breakwater at	363		2606	
Governors Island, New York Harbor, sea walls at	13 461			
Gowanus Bay, N. Y., improvement of	93 817			
Gowanus Creek Channel, New York Harbor, improvement of	93 817			
Grand Haven Harbor, Mich., improvement of	326		2340	
Grand Marais, Mich., improvement of harbor of refuge at	301		2145	
Grand Marais, Minn., improvement of harbor at	296		2121	
Grand River, Mich., below Grand Rapids, examination and survey of	331		2369	
Grand River, Ohio, below Richmond, examination and survey of	352		2511	
Grand River, Ohio. (*See also* Fairport Harbor.)				
Gravesend Bay, N. Y., establishment of harbor lines in	398 849			
Gravesend Bay, N. Y., removal of wreck in	97 838			
Great Chazy River, N. Y., improvement of	363		2605	
Great Falls, Potomac River, erection of fishways at	417			3382
Great Kanawha River, W. Va., improvement of	286		2041	
Great Kanawha River, W. Va., injury to channels and improvements in				3342
Great Kanawha River, W. Va., operating and care of locks and dams on	287		2062	
Great Lakes. (*See* Northern and Northwestern lakes.)				
Great Miami embankment, Ind	276		1963	
Great Pedee River, S. C., improvement of	171	1203		
Great Pedee River, S. C., near Society Hill, bridge obstructing	411			
Great Sodus Bay, N. Y., improvement of harbor at	358		2561	
Green Bay Harbor, Wis., improvement of	306		2180	
Green Jacket Shoal, Providence River, R. I., removal of	59 621			
Green River, Ky., operating and care of locks and dams on	290		2074	
Greenport Harbor, N. Y., improvement of	80 711			
Greenwich Bay, R. I., improvement of	60 623			
Grosse Pointe Channel, Mich., improvement of	342		2478	
Gulf, Colorado and Santa Fe Railway Company, bridge of	412			
Guyandotte River, W. Va., improvement of	294		2111	
H.				
Hampton Creek and Bar, Va., improvement of	150	1069		
Hampton Roads, Va., construction of mining casemate at	8			
Hampton Roads, Va., fortifications for defense of	8			
Harbor and river improvements	21			
Harbor lines, establishment of	21 397			
Anacostia River, Washington, D. C	398	1079		
Bellingham Bay, Wash	399		2794	
Five-Mile River Harbor, Conn	398 730			
New York Harbor and adjacent waters	398 849			
Norfolk navy-yard, Va	399	1097		
Olympia, Wash	399		2794	
Portage Lake, Mich	303		2165	
Portland, Oregon	399		2869	
San Diego Harbor and adjacent waters, Cal	399		2640	
San Pedro, Wilmington Harbor, Cal	399		2638	
Vancouver, Wash	399		2794	
Harlem River, N. Y.:				
Bridge at Broadway, New York, construction of	406			
Bridge at Fourth avenue, New York, construction of	406			

Subject.	Page. Part I.	Part II.	Part III.	Part IV.
Harlem River, N. Y.—Continued.				
Bridge (temporary) at 156th street, New York, construction of	406			
Improvement of	88 778			
Harlowe River, N. C., improvement of	161	1134		
Harraseeket River, Me., improvement of	31 516			
Havana, Ill., construction of bridge across Illinois River at	409			
Havre de Grace, Md., examination and survey of Susquehanna River above	131 994			
Havre de Grace, Md., improvement of Susquehanna River near	124 966			
Hay Lake Channel, St. Marys River, Mich., improvement of	333		2443	
Hell Gate, N. Y., improvement of	90 797			
Herr Island Dam, Allegheny River, Pa., construction of	280		1996	
Hiawassee River, Tenn., improvement of	267	1920		
Highland Beach, N. J., construction of bridge across Shrewsbury River at	401			
Hingham Harbor, Mass., improvement of	48 585			
Hog Island, Va., removal of wreck off	131 980			
Holland Harbor, Mich., improvement of	327		2348	
Holmes River, Fla., improvement of	196	1407		
Housatonic River, Conn., improvement of	73 680			
Houston, Tex., city and railway bridges obstructing Buffalo Bayou	412			
Hudson River, N. Y., improvement of	84 734			
Hudson River, N. Y., near Twenty-third street, New York City, construction of bridge across	403			
Hudson River, N. Y., report of board on improvement of	85 750			
Humboldt Harbor and Bay, Cal., improvement of	373		2656	
Hunting Creek, Va., at Alexandria, construction of bridge across	409			
Huntington Harbor, N. Y., improvement of	81 717			
Huntress (schooner), removal of wreck of	39 533			
Huron Lake, improvement of harbor of refuge at Sand Beach, Mich	337		2464	
Huron, Lake. (*See also* Northern and Northwestern lakes.)				
Huron, Ohio, construction of bridge across Huron River at	402			
Huron, Ohio, improvement of harbor of	347		2498	
Huron River, Ohio, at Huron, construction of bridge across	402			
Hyannis, Mass., improvement of harbor of refuge at	52 598			
Hyannis, Mass., removal of wreck near	65 638			
I.				
Illinois and Mississippi Canal, Ill., construction of	320		2297	
Illinois River, Ill.:				
Bridge at Havana, construction of	409			
Bridge between Columbiana and Kampsville, construction of	401			
Improvement of	318		2255	
Operating and care of La Grange Lock and Dam	319		2294	
Improvements of rivers and harbors	21			
Indiana Chute, Falls of Ohio River, improvement of	283		2020	
Injury to public works by corporations or individuals	22 413			3341
Inland waterways. (*See* Waterways.)				
Inside routes, waterways, etc. (*See* Waterways.)				
Ipswich River, Mass., improvement of	42 557			
Isabel Alberto (schooner), removal of wreck of	39 533			
J.				
Jacksonville, Tampa and Key West Railway Company, bridge of	407			
Jamaica Bay, N. Y., examination and survey for waterway eastward from	97 840			
James River, Va., improvement of	134	1012		
Jefferson, Tex., and Shreveport, La., survey of lakes between	240	1668		
Jekyl Creek, Ga., improvement of	170	1283		
Jersey Flats, N. J., modification of harbor lines in	398 854			
Johnsonville, Tenn., reconstruction of bridge across Tennessee River at	401			
Jones, Lucy (schooner), removal of wreck of	65 638			
Judith Point, R. I., construction of harbor of refuge at	62			

Subject.	Page.			
	Part I.	Part II.	Part III.	Part IV.
K.				
Kampsville, Ill., construction of bridge across Illinois River at	401			
Kanawha and Michigan (Ohio) Railway Company, bridge of	408			
Kaskaskia River, Ill., improvement of	252	1745		
Kennebec River, Me., between Waterville and Augusta, examination and survey of	39 541			
Kennebec River, Me., construction of bridge across Atkins Bay at Phippsburg	405			
Kennebec River, Me., improvement of	30 513			
Kennebunk River, Me., improvement of	35 524			
Kenosha Harbor, Wis., improvement of	312		2207	
Kenton County and Campbell County Bridge Company, bridge of	404			
Kentucky River, Ky., at Frankfort, bridge obstructing	411			
Kentucky River, Ky., improvement of	291		2083	
Kentucky River, Ky., operating and care of locks and dams on	292		2091	
Kewaunee, Green Bay and Western Railroad Company, bridge of	410			
Kewaunee Harbor, Wis., improvement of	308		2187	
Kewaunee River, Wis., at Kewaunee, construction of bridge across	410			
Kewaunee, Wis., construction of bridge across Kewaunee River at	410			
Keweenaw Point, Mich., improvement and operating and care of canals across	302		2158	
Key West Harbor, Fla., improvement of northwest entrance to	186	1374		
Keyport Harbor, N. J., improvement of	106 889			
Kings County, N. Y., bridge of, obstructing Newtown Creek	411			
Kinnickinnic River, Wis., at Clinton street, Milwaukee, construction of bridge across	410			
Klaskuine River, Oregon, improvement of	393		2839	
L.				
La Playa, Cal., establishment of harbor lines at	399		2640	
Lafayette, Oregon, reconstruction of bridge across Yamhill River, near	402			
Lafourche Bayou, La., improvement of	217	1487		
La Grange Bayou, Fla., improvement of	196	1407		
La Grange Lock and Dam, Illinois River, Ill., operating and care of	319		2294	
Laidlaw, Wash., construction of bridge across South Bay, Elk River, at	408			
Lake Shore and Michigan Southern Railway Company, bridges of	402 403			
Lakes, Great. (*See* Northern and Northwestern lakes.)				
Lakes, Northern and Northwestern. (*See* Northern and Northwestern lakes.)				
Land and River Improvement Company of Everett, Wash., bridge of	406			
Larchmont Harbor, N. Y., improvement of	78 704			
Laws of 52d Cong., 1st sess., affecting Corps of Engineers				3463
Leaf River, Miss., improvement of	211	1458		
Leavenworth and Platte County Bridge Company, bridge of	405			
Leavenworth, Kans., construction of bridge across Missouri River at	405			
Legislation proposed for establishment and enforcement of rules and regulations for use of canals	22			
Legislation proposed to prevent dumping of ballast in approaches to New York Harbor	395		2885	
Leonardtown, Md., improvement of harbor at Breton Bay	141	1045		
Levisa Fork of Big Sandy River, Ky., improvement of	293		2108	
Lewes, Del., construction of iron pier near	115 931			
Lewes, Del., improvement of inland waterway between Chincoteague Bay, Va., and Delaware Bay, near	123 956			
Lewis County, Wash., construction of bridge across Cowlitz River by	401			
Licking River, Ky., between Farmers and West Liberty, improvement of	292		2097	
Licking River, Ky., between Newport and Covington, construction of bridge across	404			

Subject.	Page.				
	Part I.		Part II.	Part III.	Part IV.
Limestone County, Ala., construction of bridge across Elk River by	402				
Litchfield, Carrollton and Western Railroad Company, bridges of	401				
Little Harbor, N. H., improvement of harbor of refuge at	38	531			
Little Kanawha River, W. Va., improvement of	295			2114	
Little Kanawha River, W. Va., operating and care of lock and dam on	295			2117	
Little Pedee River, S. C., improvement of	171		1201		
Little Red River, Ark., improvement of	245		1687		
Little River, Mo., improvement of	247		1696		
Little Sodus Bay, N. Y., improvement of harbor at	359			2572	
Littles Point, Lake Erie, survey of shoals off	420				3467
Livingston Point, Ky., improvement of	267		1916		
Locks and dams. (*See* Canals.)					
Lockwoods Folly River, N. C., improvement of	167		1177		
Long Beach Inlet, N. Y., examination and survey for waterway between Jamaica Bay and	97	840			
Louisville and Portland Canal, Ky., operating and care of	284			2024	
Louisville, Ky., improvement of Falls of Ohio River at	283			2015	
Lubec Channel, Me., improvement of	24	495			
Ludington Harbor, Mich., improvement of	324			2326	
Lumber River, N. C. and S. C., improvement of	170		1199		
Lynden, Wash., construction of bridge across Nooksack River at	408				
Lynn Harbor, Mass., improvement of	45	572			
Lynnhaven Bay, Va., examination and survey for harbor of refuge at	147		1076		
M.					
Mackeys Creek, N. C., improvement of	156		1113		
Maçon, Bayou, La., improvement of	233		1617		
Macon, Dublin and Savannah Railroad Company, bridge of	406				
Macon, Ga., construction of bridge across Ocmulgee River at	406				
Manasquan River, N. J., improvement of	109	897			
Manatee River, Fla., improvement of	188		1384		
Manchac, Bayou, La., improvement of	217		1485		
Manchester Harbor, Mass., improvement of	44	569			
Manistee Harbor, Mich., improvement of	323			2322	
Manistique Harbor, Mich., improvement of	303			2170	
Manitowoc Harbor, Wis., improvement of	309			2191	
Manitowoc River, Wis., at Manitowoc, reconstruction of bridge across	404				
Manitowoc, Wis., reconstruction of bridge across Manitowoc River at Eighth street by city of	404				
Manokin River, Md., improvement of	129	976			
Maps, military and other	423				
Marcus Hook, Pa., improvement of ice harbor at	114	929			
Marion, Fort, Fla., repair and preservation of	15	471			
Marquette Harbor, Mich., improvement of	300			2142	
Marthas Vineyard, Mass., examination and survey of Menemsha Bight	66	642			
Marthas Vineyard, Mass., improvement of inner harbor at Edgartown	53	602			
Mattaponi River, Va., improvement of	145		1059		
Mattawan Creek, N. J., improvement of	107	890			
Maumee River and Bay, Ohio. (*See* Toledo Harbor.)					
Maurice River, N. J., improvement of	119	938			
Menemsha Bight, Mass., examination and survey of	66	642			
Menominee Harbor, Mich. and Wis., improvement of	304			2173	
Menominee River, Mich. and Wis., improvement of	304			2175	
Merrimac River, Mass., improvement of	40	554			
Michigan City Harbor (outer and inner), Mich., improvement of	330			2365	
Michigan, Lake. (*See* Northern and Northwestern lakes.)					
Milbridge, Me., reconstruction of bridge across Narraguagus River by town of	407				
Milford Harbor, Conn., improvement of	73	677			
Military departments, reconnaissances, explorations, and surveys in	424				3457
Milwaukee Bay, Wis., improvement of harbor of refuge at	311			2199	
Milwaukee Harbor, Wis., improvement of	311			2201	
Milwaukee, Lake Shore and Western Railway Company, bridges of	402	401			

Subject.	Page.			
	Part I.	Part II.	Part III.	Part IV.
Milwaukee, Wis., construction of bridge across Kinnickinnic River at Clinton street by city of	410			
Mingo Creek, S. C., improvement of	171	1208		
Mining casemates, construction of	8			
Minnesota Point, at Superior, Wis., improvement of	299		2137	
Minnesota River, Minn., improvement of	260	1840		
Mispillion Creek, Del., improvement of	122 953			
Mispillion River, Del., examination and survey of	131 988			
Mississippi River:				
Examination and survey to determine effect of backwater at Clarendon and Lower White River, Ark	247	1697		
Gauging, and its principal tributaries	239	1663		
Gauging, near St. Paul, Minn	261	1849		
Improvement of, above St. Anthony Falls, Minn.	256	1816		
Improvement of, below mouth of Ohio River (report of Mississippi River Commission)	396			2887
Improvement of, between Des Moines Rapids and mouth of Illinois River	253	1766		
Improvement of, between Minneapolis and Des Moines Rapids	255	1779		
Improvement of, between Ohio and Illinois rivers	249	1713		
Improvement of Des Moines Rapids	254	1772		
Improvement of St. Louis Harbor, Mo	250	1737		
Operating and care of Des Moines Rapids Canal and Dry Dock	255	1773		
Plaquemine, Bayou, La., bank protection at mouth of	223	1517		
Reservoirs at headwaters of	257	1818		
Reservoirs at sources of, surveys for		1849		
Snag boats and dredge boats on upper river, operation of	253	1749		
Snags and wrecks, removal of	248	1705		
South Pass, inspection of improvement of	22 215	1469		
Survey of	396			2888 2914
Wreck off Point Celeste, La., removal of	224	1521		
Mississippi River Commission, report of	396			2887
Missouri, Department of the, report of engineer officer	424			3457
Missouri River:				
Bridge at Leavenworth, Kans., construction of	405			
Examination of, between Great Falls and canyon next below Stubbs Ferry, Mont	265	1904		
Improvement, etc., of, below Sioux City, Iowa (report of Missouri River Commission)	397			3251
Improvement of, between Great Falls, Mont., and Sioux City, Iowa	263	1875		
Missouri River Commission, report of	397			3251
Mobile Harbor, Ala., improvement of	206	1435		
Mokelumne River, Cal., improvement of	372		2051	
Molton (steamer), removal of wreck of	180	1292		
Monomoy, Mass., removal of wrecks near	66 641			
Monongahela River, W. Va. and Pa.:				
Bridge at Pittsburg, construction of	403			
Improvement of	278		1984	
Lock and Dam No. 6, purchase of	279		1990	
Lock and Dam No. 7, purchase of	279		1989	
Locks and Dams Nos. 8 and 9, operating and care of	279		1986	
Monroe, Fort, Va., beach protection, water supply, and sewerage system at	14 465			
Monroe Harbor, Mich., improvement of	344		2486	
Moore, Hannah (scow), removal of wreck of	344		2483	
Moosabec Bar, Me., improvement of	24 496			
Moosabec Reach, Me., removal of wreck near	39 533			
Mount Calvert, Md., construction of bridge across Patuxent River at	405			
Mount Desert to Porcupine Island, Me., construction of breakwater from	25 500			
Mount Vernon, Va., improvement of Potomac River at	138	1028		
Mount Vernon, Wash., construction of bridge across Skagit River at	407			
Murderkill River, Del., examination and survey of	131 981			
Muscle Shoals Canal, Tennessee River, operating and care of	275	1956		
Muskegon Harbor, Mich.:				
Improvement of	325		2333	
Injury to Government dredge at				3345
Muskingum River, Ohio:				
Improvement of	281		1999	
Improvement of ice harbor at mouth of	281		1997	
Operating and care of ice-harbor lock at mouth of	281		1998	
Operating and care of locks and dams on	282		2000	
Mystic River, Conn., improvement of	67 650			

SUBJECT.	Page.				
	Part I.		Part II.	Part III.	Part IV.
N.					
Nansemond River, Va., improvement of	150		1090		
Nantucket, Mass., improvement of harbor of refuge at	53	600			
Nantucket Sound, Mass., removal of wrecks in	65 66 639	638 640			
Napa, Cal., construction of bridge across Napa River by city of	410				
Napa River, Cal., at Napa, construction of bridge across	410				
Napa River, Cal., improvement of	367			2622	
Narragansett Bay, R. I., construction of mining casemates at	8				
Narragansett Bay, R. I., improvement of	59	618			
Narraguagus River, Me., at Milbridge, reconstruction of bridge across	407				
Narraguagus River, Me., improvement of	25	498			
Narrows of Lake Champlain, N. Y. and Vt., improvement of	365			2614	
Nashawena Island, Mass., examination and survey of Canapitsit Channel, near	66	645			
Nashville, Chattanooga and St. Louis Railway Company, bridge of	401				
Natalbany River, La., improvement of	216		1484		
National City, Cal., establishment of harbor lines at	399			2610	
Navesink Railroad Company, bridge of	401				
Navigable waters, bridges obstructing	21	410			
Navigable waters, construction of bridges across	21	400			3315
Navigation, bridges obstructing	21	410			
Neches River, Tex., improvement of	222		1511		
Nehalem Bay, Oregon, improvement of entrance to	380			2703	
Neshawana Island, Mass. (*See* Nashawena Island.)					
Neuse River, N. C., improvement of	160		1129		
New Bedford Harbor, Mass., improvement of	55	609			
New Castle, Del., improvement of ice harbor at	121	948			
New Haven, Conn., construction of breakwaters at	72	673			
New Haven Harbor, Conn., improvement of	71	668			
New London, Wis., reconstruction of bridge across Wolf River at	404				
New River, N. C., improvement of	163		1149		
New River, N. C., improvement of inland waterway between Beaufort Harbor and	162		1141		
New River, N. C., improvement of inland waterway between Swansboro and	163		1146		
New River, Va. and W. Va. improvement of	289			2071	
New Rochelle, N. Y., improvement of Echo Harbor	79	706			
New Whatcom, Wash., establishment of harbor lines at	399			2794	
New York Central and Hudson River Railroad Company, bridges of	406				
New York Harbor:					
Davids Island, sea wall and embankment at	12	457			
Dumping of ballast off Sandy Hook at entrance to, and recommendations and proposed legislation for prevention	395			2882	
Fortifications for defense of	5	0			
Governors Island, sea walls at	13	461			
Harbor lines in, and adjacent waters, establishment of	398	849			
Improvement of	95	824			
Improvement of Arthur Kill	100	869			
Improvement of Buttermilk Channel	92	814			
Improvement of channel between Staten Island and New Jersey	101	871			
Improvement of channels in Gowanus Bay	93	817			
Improvement of East River and Hell Gate	90	797			
Supervision of	395			2879	
Wrecks in, removal of	97	838			
New York, N. Y.:					
Bridge across Harlem River at Broadway, construction of	406				
Bridge across Harlem River at Fourth avenue, reconstruction of	406				
Bridge across Harlem River at One hundred and fifty-sixth street, construction of temporary, by city	406				
Bridge across Hudson River near Twenty-third street, construction of	403				
Newark Bay, N. J., injury to dike in					3343
Newbern, N. C., improvement of inland waterway between Beaufort and	161		1134		
Newburyport Harbor, Mass., improvement of	40	551			
Newport Harbor, R. I., improvement of	61	625			

Subject.	Page. Part I.	Part II.	Part III.	Part IV.
Newport, Ky., construction of bridge across Licking River at	404			
Newport River, N. C., improvement of	161	1134		
Newtown Creek, N. Y., bridge obstructing	411			
Newtown Creek, N. Y., improvement of	91 810			
Niagara Falls, N. Y., examination and survey of Port Day above	357		2539	
Niagara, Fort, N. Y., protection of site of	12 453			
Niagara River, N. Y., above Tonawanda, improvement of	355		2533	
Niagara River, N. Y., at Port Day, above Niagara Falls, examination and survey of	357		2539	
Niagara River, N. Y., discharges of	420			
Nomini Creek, Va., improvement of	141	1047		
Nooksack River, Wash., at Ferndale, construction of bridge across	408			
Nooksack River, Wash., at Lynden, construction of bridge across	408			
Nooksack River, Wash., improvement of	383		2729	
Norfolk Harbor, Va., and approaches, improvement of	147	1085		
Norfolk Harbor, Va., and navy-yard, improvement of approaches to, between Lambert Point and Fort Norfolk	149	1089		
Norfolk Harbor, Va., improvement of inland route between Albemarle Sound, N. C., and	152	1094		
Norfolk, Va., modification of harbor lines at the navy-yard	399	1097		
North East (Cape Fear) River, N. C., improvement of	164	1152		
North East River, Md., improvement of	124 967			
North Landing River, Va. and N. C., improvement of	153	1096		
North River Bridge Company, bridge of	403			
Northern and northwestern lakes:				
Charts, correction, printing, and distribution of	419			3407
Estimates	421			3414
Surveys	419			3424
Water levels	422			3429
Northern Pacific Railroad Company, bridge of	412			
Norwalk Harbor, Conn., improvement of	75 692			
Nowell, Florence (schooner), removal of wreck of	66 641			
Noxubee River, Miss., improvement of	210	1452		
Nuphar (steamer), removal of wreck of	119 940			
O.				
Oak Orchard Harbor, N. Y., improvement of	356		2537	
Oakes, Allie (schooner), removal of wreck of	65 638			
Oakland Harbor, Cal., improvement of	365		2617	
Occoquan Creek, Va., improvement of	139	1039		
Occupancy of public works by corporations or individuals	22 413			3341
Ocean Springs Bridge Company, bridge of	402			
Ocean Springs, Miss., construction of bridge across Fort Bayou at	402			
Ocklawaha River, Fla., improvement of	183	1366		
Ocmulgee River, Ga., at Macon, construction of bridge across	406			
Ocmulgee River, Ga., improvement of	178	1271		
Oconee River, Ga., improvement of	178	1265		
Oconto Harbor, Wis., improvement of	305		2177	
Ocracoke Inlet, N. C., improvement of	157	1115		
Office of the Chief of Engineers	425			
Ogdensburg Harbor, N. Y., improvement of	362		2601	
Ohio River:				
Bridge between Cincinnati, Ohio, and Covington, Ky., construction of	407			
Dam below mouth of Beaver River, Pa., construction of	278		1983	
Improvement of	275		1960	
Improvement of Falls of, Louisville, Ky	283		2015	
Improvement of Indiana Chute, Falls of	283		2020	
Operating and care of Davis Island Dam, Pa	277		1980	
Operating and care of Louisville and Portland Canal, Ky	284		2024	
Snagboats on, operation of	277		1978	
Oil City, Pa., construction of bridge across Allegheny River at	410			
Olcott Harbor, N. Y., improvement of	356		2536	
Oliver, Mary E. (schooner), removal of wreck of	65 639			
Olympia Harbor, Wash., examination and survey of	384		2733	
Olympia, Wash., establishment of harbor lines at	399		2794	
Onancock Harbor (or River), Va., improvement of	129 977			
Ontario, Lake, survey of Black Creek Shoal	420			3428

Subject.	Page. Part I.	Page. Part II.	Page. Part III.	Page. Part IV.
Ontario, Lake. (*See also* Northern and northwestern lakes.)				
Ontonagon Harbor, Mich., improvement of	299		2139	
Oregonian Railroad Company, bridge of	402			
Osage River, Mo., improvement of	251	1742		
Oshkosh, Wis., construction of bridge across Fox River at Wisconsin avenue, by city of	403			
Oswego Harbor, N. Y., improvement of	360		2581	
Otter Creek, Vt., improvement of	365		2612	
Ouachita River, Ark. and La., improvement of	231	1602		
Oyster Bay, Tex., near Christmas Point, examination and survey of	228	1563		
P.				
Pacific coast between Points Dume and Capistrano, Cal., examination for deep harbor on	370		2630	
Packard, R. G., modification of harbor lines in Jersey Flats, New York Harbor, to permit constructions by	398 854			
Padilla Bay, Wash., and Skagit Bay, Wash., examination and survey for ship channel through Swinomish Slough connecting	384		2752	
Paducah, Ky., improvement of Livingston Point	267	1916		
Pamlico River, N. C., improvement of	158	1118		
Pamlico River, N. C., removal of wreck opposite Swan Point	169	1194		
Pamunkey River, Va., improvement of	146	1062		
Pascagoula River, Miss., improvement of	210	1453		
Pasquotank River, N. C., improvement of	156	1111		
Passaic River, N. J., improvement of	102 873			
Passaic River, N. J., improvement of, above Newark	102 876			
Passaic River, N. J., improvement of, below Newark	102 873			
Passaic River, N. J., injury to dike				3342
Patapsco River, Md., improvement of	132	1005		
Patchogue River, N. Y., improvement of	83 724			
Patuxent River, Md., at Mount Calvert, near Bristol Landing, construction of bridge across	405			
Patuxent River, Md., improvement of	142	1049		
Pawcatuck River, R. I. and Conn., improvement of	64 633			
Pawtucket River, R. I., improvement of	58 616			
Pearl River, Miss., below Jackson, improvement of	212	1460		
Pearl River, Miss., between Edinburg and Carthage, improvement of	214	1465		
Pearl River, Miss., between Jackson and Carthage, improvement of	213	1462		
Pease Creek, Fla., improvement of	187	1379		
Pelée Point, Lake Erie, survey of shoals near	420			3407
Pelée Spit light-house, Lake Erie, survey of shoals off	420			3407
Penobscot River, Me., examination and survey of	39 533			
Penobscot River, Me., improvement of	27 504			
Pensacola Harbor, Fla., improvement of	198	1412		
Pensaukee Harbor, Wis., improvement of	305		2179	
Pentwater Harbor, Mich., improvement of	324		2328	
Perth Amboy, N. J., modification of harbor lines at	398 861			
Petaluma Creek, Cal., improvement of	373		2655	
Petit Jean River, Ark., improvement of	243	1682		
Petoskey Harbor, Mich., improvement of	321		2314	
Philadelphia Harbor, Pa., improvement of	112 906			
Philadelphia Harbor, Pa., removal of wreck in	119 940			
Philadelphia, Pa., construction of mining casemates at	8			
Phippsburg, Me., construction of bridge across Atkins Bay at	405			
Piers, etc., occupancy or injury of	22 413			3341
Pine Lake, Mich., improvement of entrance to	322		2315	
Pittsburg, Pa.:				
Bridge across Allegheny River, construction of	408			
Bridge across Monongahela River, construction of	403			
Davis Island Dam, operating and care of	277		1960	
Herr Island Dam, Allegheny River, construction of	280		1996	
Plaquemine, Bayou, La., improvement of	218	1491		
Plaquemine, Bayou, La., prevention of further caving at mouth of	223	1517		
Platte, department of the, report of engineer officer	424			3459
Plattsburg Harbor, N. Y., improvement of	364		2607	
Pleasant River, Me., improvement of	24 408			
Plymouth County, Mass., construction of bridge across Cohasset Narrows by Barnstable County and	404			
Plymouth Harbor, Mass., improvement of	50 588			

Subject.	Page. Part I.	Part II.	Part III.	Part IV.
Point Judith, R. I., construction of harbor of refuge at	62 628			
Pollock Rip, Mass., removal of wrecks on and near	65 66 637 640 641			
Ponchatoula River, La., improvement of	216	1484		
Porcupine Island, Me., construction of breakwater from Mount Desert to	25 500			
Port Chester Harbor, N. Y., improvement of	77 702			
Port Clinton Harbor, Ohio, improvement of	346		2494	
Port Clinton Harbor, Ohio, removal of wrecks in	352		2510	
Port Day, N. Y., above Niagara Falls, examination and survey of	357		2539	
Port Huron, Mich., improvement of Black River at	339		2469	
Port Jefferson Inlet, N. Y., improvement of harbor at	80 713			
Port Washington Harbor, Wis., improvement of	310		2196	
Portage Canal, Wis., reconstruction of bridge across	403			
Portage City, Wis., reconstruction of bridge across Portage Canal near	403			
Portage Lake and Lake Superior canals, across Keweenaw Point, Mich., improvement and operating and care of	302		2158	
Portage Lake, Mich., harbor lines in	303		2165	
Portage Lake, Mich., improvement of harbor of refuge at	323		2320	
Portland Harbor, Me., improvement of	32 517			
Portland Harbor, Me., improvement of channel in Back Cove	33 520			
Portland, Me., construction of mining casemate at	8			
Portland, Oregon:				
Bridges across Willamette River, construction of, by city	409			3823
Examination and survey for 25-foot channel in Willamette and Columbia rivers below	394		2850	
Harbor lines at, establishment of	399		2869	
Improvement of Willamette and Columbia rivers at and below	389		2829	
Improvement of Willamette River above	391		2835	
Portsmouth Harbor, N. H., improvement of	36 527			
Post of Willets Point, N. Y	19 473			
Potomac Flats, Washington, D. C., trespasses upon				3344
Potomac River:				
Bridge at Three Sisters, near Washington, D. C., construction of	405			
Eastern Branch of. (*See* Anacostia River.)				
Examination and survey of	147	1069		
Fishways at Great Falls, erection of	417			3382
Improvement of, at Mount Vernon, Va	138	1038		
Improvement of, at Washington, D. C	136	1030		
Trespasses on Potomac Flats				3344
Powow River, Mass., improvement of	41 556			
Presque Isle Peninsula, Erie Harbor, Pa., preservation and protection of	353		2526	
Providence River, R. I., improvement of	59 618			
Providence River, R. I., removal of Green Jacket Shoal	59 621			
Provincetown Harbor, Mass., improvement of	51 593			
Public buildings and grounds, Washington, D. C., improvement and care of	418			3385
Public works, occupancy or injury of	22 413			3341
Puget Sound, Wash., examination and survey for ship channel through Swinomish Slough, connecting Saratoga Passage and Skagit Bay with Padilla Bay	384		2752	
Puget Sound, Wash., examination for ship canal to connect lakes Union, Washington, and Samamish with	385		2762	
Pultneyville Harbor, N. Y., improvement of	358		2557	
Python (schooner), removal of wreck of	66 640			
Q.				
Queens County, N. Y., bridge of, obstructing Newtown Creek	411			
R.				
Racine Harbor, Wis., improvement of	312		2204	
Rahway River, N. J., improvement of	104 880			
Rancocas River, N. J., improvement of	117 935			
Rancocas River, N. J., removal of wreck in	119 940			
Rappahannock River, Va., improvement of	143	1050		
Raritan Bay, N. J., establishment of harbor lines in	398 849			
Raritan Bay, N. J., improvement of	96 833			
Raritan Bay, N. J., removal of wreck in	97 839			

Subject.	Page.				
	Part I.		Part II.	Part III.	Part IV.
Raritan River, N. J., improvement of	104	881			
Reconnaissances and explorations	424				3457
Red Cedar, Wis., reconstruction of bridge across Chippewa River, near	404				
Red Hook Channel, New York Harbor, improvement of	93	817			
Red River above Fulton, Ark., improvement of	230		1600		
Red River, La. and Ark., improvement of	229		1573		
Red River of the North, Minn. and N. Dak., and tributaries above Fergus Falls and Crookston, examination and survey of	262		1853		
Red River of the North, Minn. and N. Dak., improvement of	261		1843		
Redwood Creek, Cal., improvement of	367			2623	
Relief Bridge Company, bridge of	410				
Rescue (sailboat), removal of wreck of	352			2510	
Reservoirs at head waters of Mississippi River	257		1818		
Reservoirs at sources of Mississippi, St Croix, Chippewa, and Wisconsin rivers, surveys for			1849		
Richmond, Ohio, examination and survey of Grand River below	352			2511	
River and harbor improvements	21				
Roanoke River, N. C., improvement of	155		1103		
Rock Hall Harbor, Md., examination and survey of	132	999			
Rockland Harbor, Me., improvement of	29	511			
Rockland Harbor, Me., removal of wreck in	39	533			
Rockport Harbor, Me., improvement of	29	510			
Rogers, Ann R. (schooner), removal of wreck of	131	980			
Rondeway, Bayou, La., improvement of	234		1620		
Rondout Harbor, N. Y., improvement of	87	773			
Rope, wire, tests of	491				
Roseville, Cal., establishment of harbor lines at	399			2640	
Ross Island, Oregon, examination of Willamette River at	393			2840	
Rouge River, Mich., improvement of	343			2480	
Rough River, Ky., improvement of	291			2081	
Rouse Point, Lake Champlain, N. Y., breakwater at	363			2604	
Rules and regulations for use of canals, recommendations and proposed legislation for establishment and enforcement of	22				
Ryan, Paddy (scow), removal of wreck of	119	940			
S.					
Sabine Pass, Tex., improvement of harbor at	221		1506		
Sabine River, Tex., between Sabine Lake and Sudduths Bluff, examination of	223		1513		
Sabine River, Tex., improvement of	222		1510		
Sacketts Harbor, N. Y., improvement of harbor at	361			2597	
Saco River, Me., improvement of	34	521			
Sacramento River, Cal., improvement of	372			2652	
Sagadahoc County, Me., construction of bridge across Atkins Bay by	405				
Saginaw River, Mich., improvement of	336			2454	
St. Augustine Harbor, Fla., improvement of	185		1371		
St. Clair Flats Canal, Mich., improvement of	340			2473	
St. Clair Flats Canal, Mich., injuries to piers, etc., of					3346
St. Clair Flats Canal, Mich., operating and care of	341			2475	
St. Clair River, Mich., removal of wreck in	344			2483	
St. Croix River, Me., improvement of	23	494			
St. Croix River, Wis. and Minn., improvement of	259		1837		
St. Croix River, Wis. and Minn., surveys for reservoirs at sources of			1849		
St. Francis River, Ark., improvement of	246		1693		
St. Francis River, Mo., improvement of	247		1694		
St. Johns River, Fla., at Buffalo Bluff, reconstruction of bridge across	407				
St. Johns River, Fla., improvement of	182		1349		
St. Joseph Harbor, Mich., improvement of	329			2357	
St. Joseph River, Mich., improvement of	330			2363	
St. Joseph River, Mich., near its mouth, bridge obstructing	411				
St. Lawrence River, at Ogdensburg, N. Y., improvement of	362			2601	
St. Lawrence River, N. Y., improvement of shoals between Sister Islands and Crossover Light	362			2599	
St. Lawrence River, survey of shoals in	420				3425
St. Louis Bay, Wis., improvement of harbor at	298			2132	
St. Louis Harbor, Mo., improvement of	250		1737		
St. Louis River, Wis. and Minn., below Fond du Lac, examination and survey of	302			2148	
St. Louis River, Wis. and Minn., construction of bridge across	403				

Subject.	Page.				
	Part I.		Part II.	Part III.	Part IV.
St. Marys Falls Canal, dry dock at	333			2443	
St. Marys Falls Canal, Mich., occupancy of Government lands and injuries of piers at					3345
St. Marys Falls Canal, Mich., operating and care of	332			2426	
St. Marys River, Mich., at the Falls, improvement of	331			2398	
St. Marys River, Mich., between White Fish Bay and Detour light-house, survey of	419				3407
St. Marys River, Mich., improvement of Hay Lake Channel	333			2443	
St. Matthews (steamer), removal of wreck of	180		1293		
St. Paul, Minneapolis and Manitoba Railway Company, bridge of	407				
St. Paul, Minn., gauging Mississippi River, near	261		1849		
Salem Harbor, Mass., improvement of	44	570			
Salkehatchie River, S. C., improvement of	175		1235		
Samamish Lake, Wash., examination for ship canal to connect Puget Sound with	385			2762	
San Diego, Cal., establishment of harbor lines at	399			2640	
San Diego Harbor, Cal., and adjacent waters, establishment of harbor lines in	399			2640	
San Diego Harbor, Cal., improvement of	369			2628	
San Francisco, Cal., construction of mining casemate, etc., at	8	9			
San Francisco Harbor, Cal., fortifications for defense of	8				
San Joaquin River, Cal., improvement of	370			2645	
San Luis Obispo Harbor, Cal., improvement of	368			2624	
San Pedro Bay, Cal., examination for deep harbor at	370			2630	
San Pedro, Cal., establishment of harbor lines at	399			2638	
Sand Beach, Lake Huron, Mich., improvement of harbor of refuge at	337			2464	
Sandusky Bay, Ohio, construction of bridge across	403				
Sandusky City Harbor, Ohio, improvement of	346			2495	
Sandusky River, Ohio, improvement of	347			2497	
Sandy Bay, Cape Ann, Mass., construction of harbor of refuge at	42	558			
Sandy Hook Bay, N. J., establishment of harbor lines in	398	849			
Sandy Hook, N. J., dumping of ballast in approaches to New York Harbor off	395			2882	
Santa Monica Bay, Cal., examination for deep harbor at	370			2630	
Santee River, S. C., improvement of	172		1211		
Sapelo, Ga., and Doboy, Ga., examination and survey of inside route between	181		1294		
Sarasota Bay, Fla., improvement of	188		1382		
Saratoga Passage, Wash., and Padilla Bay, Wash., examination and survey for ship channel through Swinomish Slough connecting	384			2752	
Saugatuck Harbor, Mich., improvement of	328			2350	
Saugerties Harbor, N. Y., improvement of	86	771			
Savannah, Ga., and Fernandina, Fla., examination and survey of inside route between	181		1309		
Savannah Harbor, Ga., improvement of	175		1243		
Savannah Harbor, Ga., removal of wreck in	180		1292		
Savannah River, Ga., improvement of	176		1253		
Sayville, N. Y., improvement of Browns Creek	83	727			
School, United States Engineer	19	474			
Schuylkill River, Pa., improvement of	113	923			
Scituate Harbor, Mass., improvement of	49	586			
Seattle, Wash., examination for ship canal to connect lakes Union, Washington, and Samamish with Puget Sound	385			2762	
Seybel, D. E., and Hugh N. Camp, bridge of	406				
Shawneetown embankment, Ill	277			1963	
Sheboygan Harbor, Wis., improvement of	309			2194	
Sheboygan River, Wis., in Sheboygan, reconstruction of bridge across	402				
Sheboygan, Wis., reconstruction of bridge across Sheboygan River in	402				
Sheepshead Bay, N. Y., improvement of	99	868			
Ship Island Harbor, Miss., removal of wreck in	223		1513		
Shoal Harbor, N. J., improvement of	108	892			
Shreveport, La., and Jefferson, Tex., survey of lakes between	240		1068		
Shrewsbury River, N. J., at Highland Beach, construction of bridge across	401				
Shrewsbury River, N. J., improvement of	108	894			
Sister Islands, St. Lawrence River, N. Y., removal of shoals near	362			2599	
Siuslaw River, Oregon, improvement of mouth of	378			2681	
Skagit Bay, Wash., and Padilla Bay, Wash., examination and survey for ship channel through Swinomish Slough connecting	384			2752	

Subject.	Page.			
	Part I.	Part II.	Part III.	Part IV.
Skagit County, Wash., construction of bridge across Skagit River at Mount Vernon, by	407			
Skagit County, Wash., construction of bridge across Swinomish Slough by	404			
Skagit River, Wash., at Mount Vernon, construction of bridge across	407			
Skagit River, Wash., improvement of	383		2729	
Smyrna River, Del., improvement of	121 951			
Snake River, Wash., improvement of	380		2709	
Snohomish River, Wash.:				
Bridge across, construction of	400			
Bridge at Everett, construction of	406			
Bridge at Snohomish, construction of	400			
Bridge near Snohomish, construction of	407			
Improvement of	383		2729	
Snohomish, Skykomish and Spokane Railway and Transportation Company, bridges of	400			
Snohomish, Wash., construction of bridge across Snohomish River, by city of	400			
Snohomish, Wash., construction of bridge across Snohomish River near	407			
Snoqualmie River, Wash., improvement of	383		2729	
Society Hill and Marlborough Bridge Company, bridge of	411			
Society Hill, S. C., bridge obstructing Great Pedee River near	411			
Sopelo, Ga. (*See* Sapelo.)				
South Amboy, N. J., removal of wreck near	97 839			
South arm of Willapa River, Wash., construction of bridge across	407			
South Bay, Elk River, Wash., construction of bridge across	408			
South Branch of Elizabeth River, Va., modification of harbor lines in	399	1097		
South Fork of Cumberland River, Ky., improvement of	273	1943		
South Haven Harbor, Mich., improvement of	328		2353	
South Pass of Mississippi River, inspection of improvement of	22 215			
South River, N. J., improvement of	105 887			
South River, N. J., use of dikes in				3341
South Twenty-second Street Bridge Company, bridge of	403			
Spanish Bight, Cal., establishment of harbor lines at	399		2640	
Squan River, N. J., improvement of	109 897			
Stamford Harbor, Conn., improvement of	77 699			
Staten Island, N. Y., improvement of channel between New Jersey and	101 871			
Staunton River, Va., improvement of	154	1090		
Steele Bayou, Miss., improvement of	237	1651		
Stillaguamish River, Wash., improvement of	383		2729	
Stone, tests of	490			
Stonington, Conn., improvement of harbor of refuge at	65 635			
Structures, public, occupancy or injury of	22 413			3341
Sturgeon Bay Canal, Wis., improvement of harbor of refuge at entrance of	306		2182	
Sumpawanus Inlet, N. Y., improvement of	98 863			
Superior Bay, Wis., improvement of harbor at	298		2132	
Superior Belt Line and Terminal Railway Company, bridge of	403			
Superior, Lake, and Portage Lake canals, across Keweenaw Point, Mich., improvement and operating and care of	302		2158	
Superior, Lake. (*See also* Northern and Northwestern lakes.)				
Superior, Wis., improvement of Minnesota Point at	299		2137	
Supervisor of the harbor of New York, report of	395		2879	
Susquehanna River above Havre de Grace, Md., examination and survey of	131 994			
Susquehanna River, near Havre de Grace, Md., improvement of	124 966			
Suwanee River, Fla., improvement of	191	1393		
Swansboro, N. C., improvement of inland waterway between New River and	163	1146		
Swinomish Slough, Wash., construction of bridge of Skagit County across	404			
Swinomish Slough, Wash., examination and survey of	384		2752	
T.				
Tacoma, Wash., bridge obstructing Commencement Bay at	412			
Tallahatchee River, Miss., improvement of	236	1648		
Tallapoosa River, Ala., improvement of	201	1422		

Subject.	Page. Part I.		Part II.	Part III.	Part IV.
Tampa Bay, Fla., improvement of	189		1386		
Tar River, N. C., at Tarboro, reconstruction of bridge across	408				
Tar River, N. C., improvement of	158		1118		
Tarboro, N. C., reconstruction of bridge across Tar River at	408				
Taunton River, Mass., improvement of	57	613			
Tchefuncte River, La. (*See* Chefuncte River.)					
Tchula Lake, Miss., improvement of	236		1645		
Teche, Bayou, La., improvement of	220		1503		
Teche, Bayou, La., removal of wreck in	223		1513		
Tennessee River:					
Bridge at Johnsonville, Tenn., reconstruction of	401				
Improvement of, above Chattanooga, Tenn	266		1911		
Improvement of, below Bee Tree Shoals, Ala	267		1915		
Improvement of, below Chattanooga, Tenn	275		1951		
Improvement of, between Chattanooga, Tenn., and foot of Bee Tree Shoals, Ala	273		1945		
Muscle Shoals Canal, Ala., operating and care of	275		1956		
Tensas River, La., improvement of	233		1617		
Terrebonne, Bayou, La., improvement of	218		1490		
Thames River, Conn., improvement of	67	652			
Three Sisters, near Washington, D. C., construction of bridge across Potomac River at	405				
Thunder Bay Harbor, Mich., improvement of	335			2450	
Thunder Bay River, Mich., improvement of	335			2452	
Tickfaw River and tributaries, La., improvement of	216		1484		
Ticonderoga River, N. Y., improvement of	365			2613	
Tillamook Bay and Bar, Oregon, examination and survey of	384			2742	
Tillamook Bay and Bar, Oregon, improvement of	379			2701	
Toledo Harbor, Ohio, improvement of	345			2487	
Toledo, Wash., construction of bridge across Cowlitz River at	401				
Tombigbee River, Miss. and Ala., improvement of	207		1444		
Below Demopolis	209		1450		
Between Demopolis and Columbus	209		1451		
Between Fulton and Vienna	208		1448		
Between Walkers Bridge and Fulton	208		1447		
Tonawanda Harbor, N. Y., improvement of	355			2533	
Torpedoes	20	481			
Townsend Inlet, N. J., removal of wreck at	119	940			
Tradewater River, Ky., improvement of	290			2073	
Trent River, N. C., improvement of	159		1125		
Trinity River, Tex., improvement of	226		1540		
Tug Fork of Big Sandy River, W. Va. and Ky., improvement of	294			2109	
Tulls Creek, N. C., at Tulls, bridge obstructing	411				
Tulls, N. C., bridge obstructing Tulls Creek at	411				
Tumwater, Wash., examination at	384			2733	
Two Rivers Harbor, Wis., improvement of	308			2189	
U.					
Umpqua River, Oregon, improvement of	377			2679	
Union, Lake, Wash., examination for ship canal to connect Puget Sound and Lake Washington with	385			2762	
United Railroads of Washington, bridge of	407				
Urbana Creek, Va., improvement of	143		1054		
Use of public works by corporations or individuals	22	413			
V.					
Valley Street Railway Company, bridge of	400				
Vancouver, Wash., establishment of harbor lines at	399			2794	
Vancouver, Wash., examination and survey of Columbia River near	395			2865	
Vermillion Harbor, Ohio, improvement of	348			2500	
Vidal, Bayou, La., improvement of	234		1620		
Vineyard Haven, Mass., improvement of harbor at	54	604			
Vineyard Haven, Mass., removal of wreck near	65	639			
Volusia Bar, Fla., improvement of	184		1369		
W.					
Wabash River, Ind. and Ill., improvement of	284			2031	
Wabash River, Ind. and Ill., improvement of, above Vincennes	285			2035	
Wabash River, Ind. and Ill., improvement of, below Vincennes	284			2031	
Waccamaw River, N. C. and S. C., improvement of	170		1195		
Wahkiakum County, Wash., construction of bridge across Alger or Brooks Slough by	404				
Walluski River, Oregon, construction of bridge of Clatsop County across	400				

Subject.	Page. Part I.	Part II.	Part III.	Part IV.
Wappinger Creek, N. Y., improvement of	88 776			
Wappoo Cut, S. C., improvement of	174	1231		
Wareham Harbor, Mass., improvement of	54 607			
Wareham, Mass., construction of bridge across Cohasset Narrows at town of	404			
Warren County, Ky., bridge of, obstructing Casper River	411			
Warren County, Miss., construction of bridge across Big Black River at Baldwin Ferry by	405			
Warrior River, Ala., improvement of	207	1444		
Washington, Alexandria and Mount Vernon Electric Railway Company, bridge of	409			
Washington and Arlington Railway Company, bridge of	405			
Washington and Chesapeake Beach Railway Company, bridge of	405			
Washington Aqueduct, Washington, D. C	413			3349
Washington Bayou, Miss., improvement of	237	1651		
Washington, D. C.:				
Anacostia River, examination and survey of	146	1064		
Anacostia River, improvement of	138	1035		
Bridge across Potomac River at "Three Sisters," construction of	405			
Fortifications for defense of	7			
Harbor lines in Anacostia River, establishment of	398	1079		
Long Bridge	138	1036		
Mining casemates at, construction of	8			
Potomac Flats, trespasses on				3344
Potomac River at, improvement of	136	1030		
Potomac River up to, examination and survey of	147	1069		
Public buildings and grounds, improvement and care of	418			3385
Washington Aqueduct	413			3349
Washington Monument, care of	418			3386
Water supply	416			3380
Water supply, increasing	416			3381
Washington, Lake, Wash., examination for ship canal to connect Puget Sound and Lake Samamish with	385		2762	
Washington Monument, Washington, D. C., care of	418			3386
Water supply of Washington and District of Columbia	416			3380 3381
Wateree River, S. C., improvement of	172	1214		
Waterways:				
Between Beaufort Harbor and New River, N. C., improvement of	162	1141		
Between Chincoteague Bay, Va., and Delaware Bay, improvement of	123 956			
Between Doboy and Sapelo, Ga., examination and survey of	181	1294		
Between New River and Swansboro, N. C., improvement of	163	1146		
Between Newbern and Beaufort, N. C., improvement of	161	1134		
Between Norfolk Harbor, Va., and Albemarle Sound, N. C., improvement of	152	1094		
Between Savannah, Ga., and Fernandina, Fla., examination and survey of	181	1309		
Cypress Bayou and lakes between Jefferson, Tex., and Shreveport, La., survey of	240	1668		
From Jamaica Bay eastward to Long Beach Inlet, N. Y., examination and survey for	97 840			
Waukegan Harbor, Ill., improvement of	313		2209	
Waverly Shoal, Lake Erie, survey of	420			3424
Wellfleet Harbor, Mass., improvement of	50 591			
West Bay, Tex., construction of bridge across, from Galveston Island to Virginia Point	407			
West (Galveston) Bay, Tex., near Galveston, examination and survey of	228	1503		
Westport Harbor, Mass., improvement of	56 612			
Weybosset (schooner), removal of wreck of	65 637			
Weymouth River, Mass., improvement of	48 584			
Whatcom County, Wash., construction of bridge across Nooksack River at Ferndale by	408			
Whatcom County, Wash., construction of bridge across Nooksack River at Lynden by	408			
White Lake Harbor, Mich., improvement of	325		2331	
White River, Ark., examination and survey of lower	247	1697		
White River, Ark., improvement of	244	1683		
White River Harbor, Mich., improvement of	325		2331	
White River, Ind., improvement of	285		2037	
Wicomico River, Md., improvement of	128 975			
Wilcox (tug), removal of wreck of	352		2510	

Subject.	Page.			
	Part I.	Part II.	Part III.	Part IV.
Willamette River, Oregon:				
Bridge at Albany, construction of	402			
Bridges at Portland, construction of, by city	409			8323
Examination and survey for 25-foot channel below Portland	394		2850	
Examination and survey of, at Clackamas Rapids, Ross Island, and Corvallis	393		2840	
Harbor lines at Portland, establishment of	399		2869	
Improvement of, above Portland	391		2835	
Improvement of, below Portland	389		2829	
Willapa River, Wash., construction of bridge across south arm of	407			
Willets Point, N. Y., post of	19 478			
Wilmington, Del., construction of bridge across Brandywine Creek at	400			
Wilmington, Del., improvement of harbor at	120 946			
Wilmington Harbor, Cal., establishment of harbor lines in	399		2638	
Wilmington Harbor, Cal., improvement of	368		2626	
Wilmington, N. C., improvement of Cape Fear River at	165	1164		
Wilson Harbor, N. Y., improvement of	355		2534	
Wilsons Point Harbor, Conn., improvement of	76 695			
Winthrop Habor, Mass., improvement of	46 574			
Winyaw Bay, S. C., improvement of	169	1187		
Wisconsin River, Wis., reconstruction of bridge across Portage Canal	403			
Wisconsin River, Wis., surveys for reservoirs at sources of		1849		
Withlacoochee River, Fla., improvement of	190	1389		
Wolf River at New London, Wis., reconstruction of bridge across	404			
Woodbury, J. B. (schooner), removal of wreck of	66 641			
Works, public, occupancy or injury of	22 413			3341
Wrecks, removal of	21			
Browneys Island, Moosabec Reach, Me	39 533			
Cobbs Island, Va., off	131 980			
Cooper River, S. C	175	1240		
Darien Harbor, Ga	180	1292		
Delaware River at Philadelphia, Pa	119 940			
Gravesend Bay, New York Harbor	97 838			
Hog Island, Va., off	131 980			
Mississippi River, off Point Celeste, La	224	1521		
Monomoy, Mass., near	66 641			
Nantucket Sound, Mass	65 66 638 639 640			
Pamlico River, N. C., opposite Swan Point	169	1194		
Pollock Rip, Mass., on and near	65 66 637 640 641			
Port Clinton Harbor, Ohio	352 0		2510	
Rancocas River, N. J	119 949			
Raritan Bay, N. J., near South Amboy	97 833			
Rockland Harbor, Me	39 533			
St. Clair River, Mich	344		2483	
Savannah Harbor, Ga	180	1292		
Ship Island Harbor, Miss	223	1513		
Teche, Bayou, La	223	1513		
Townsend Inlet, N. J	119 940			
Y.				
Yadkin River, N. C., improvement of	168	1181		
Yamhill River, Oregon, near Lafayette, reconstruction of bridge across	402			
Yaquina Bay, Oregon, improvement of harbor at	378		2694	
Yazoo River, Miss., improvement of	235	1624		
Yazoo River, Miss., survey and project for improvement of mouth of	235	1626		
Yellow Banks, Wis., improvement of	258	1833		
Yellowstone National Park, construction and improvement of roads and bridges in	422			3433
Yellowstone River, Mont. and N. Dak., improvement of	264	1903		
York, Andrew J. (schooner), removal of wreck of	65 688			
York Harbor, Me., improvement of	35 526			
York River, Va., improvement of	144	1056		
Youghiogheny River, Pa., at Boston, construction of bridge across	408			
Youngs River, Oregon, improvement of	393		2839	

Stanford University Libraries
3 6105 009 855 474